Allied Vision

member of the TKH Group


Enova – Paris 2017

# Embedded Vision

## Develop your own Smart Camera

Christophe MOREAU| 2017-09

# Presentation content

- Allied Vision Technologies GmbH – Company presentation
- What are Embedded Systems?
- What is Embedded Vision?
- Machine Vision Basics – Different types
- Develop your own Smart Camera - Why?
- Develop your own Smart Camera - How?
- A few configuration examples
- Roadmap to Embedded Design optimization
- RESUME & Questions?



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# Allied Vision Technologies GmbH


**Quality designed and made by Allied Vision**

**since 26 years of excellence**

// In-house development and manufacturing

// Widest product range in the market for nearly all machine vision applications

// Cutting-edge digital technology

- High resolution, high sensitivity
- Visible and infrared spectrum
- Large choice of standard interfaces



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# Allied Vision Technologies GmbH – The right camera choice

## Essential

Ultra-compact, affordable cameras with basic feature set for simple plug-and-play integration into commonly used image-processing systems.


Guppy PRO


Mako

## Enhanced

Versatile cameras offering a large choice of sensors, modular options, and integrated image optimization functions for advanced machine vision applications.


Manta


Stingray

## Extreme

High-performance cameras with special features such as high resolution, extended operating temperature range or infrared sensitivity to fulfill the most demanding requirements.


Prosilica GT


Goldeye

## Tailor-made solutions


// Modular Concept for quick and economical modifications

// Customer-specific modifications

// OEM development



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# Allied Vision Technologies GmbH – The right camera choice

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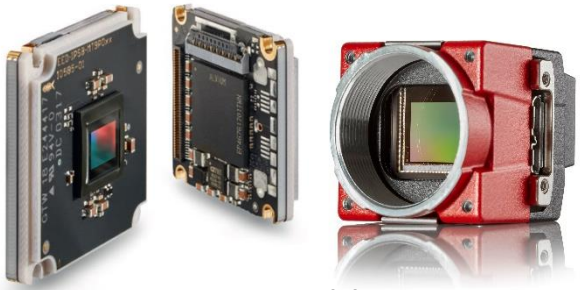
## 1 Product Line



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rosilica GT Goldey

NEW!!

// Concept for quick and economical modifications
// Customer-specific modifications
// OEM development



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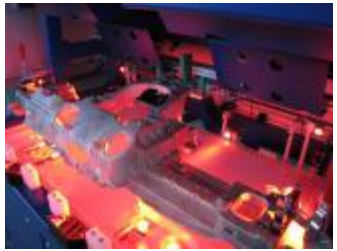
# Allied Vision Technologies GmbH – Camera Everywhere

## Industrial Inspection



**Ziemann & Urban**
Inspection of BMW instrument panel carriers

## Healthcare & Medical

**Carl Zeiss Meditec**
Opthtalmologic examination device

## Science & Nature

**NASA**
ISS astronaut-robot Robonaut 2

## Security & Traffic

**Kria**
Radar-free speed enforcement

## Multimedia & Entertainment


**Forever 21/space150**
Times Square, NYC giant interactive billboard



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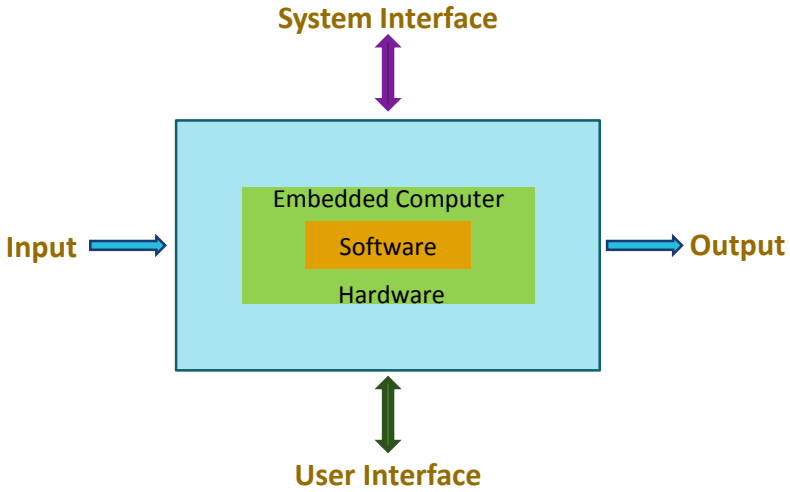
# What are Embedded Systems?

- An embedded system is a hardware system (processor) having software embedded in it , as an independent system or part of a larger system
- Embedded systems account for 97% of all processor usage
- Constructed with programmable components or application specific hardware that performs some or all of the required processing
- Typically is not End-User Programmable (but can be configurable)
- A Reactive Real-Time System, usually involving some external sensor input



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# What are Embedded Systems? Some examples



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# What is Embedded Vision?

- Embedded Vision systems are a small fraction of the overall embedded market (by application, not units)
- High-volume Embedded Vision applications are Automotive (ADAS) and mobile devices, which drives the embedded vision market valuation (2D, 3D, Stereo, ToF,…)
- Most embedded systems do not involve vision, but many require a sensor input (temperature, pressure, proximity, time, encoder, GPS, IMU, RADAR, etc.)
- Embedded vision systems tend to perform all image processing locally, similar to other sensor inputs
- Embedded vision systems, compared to other embedded systems, typically incorporate **more capable processors** and **require more software**

# What is Embedded Vision?




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# Machine Vision Systems – Basics for Vision

**Solution of an image processing application with reproducible results required:**

// 5 main hardware components for best image quality and process on time :

- Illumination
  (ambient light, object surface, features of the material…)
- Optics
  (lenses + filters)
- Camera
  (resolution, refresh rate, sensibility, synchronization…)
- Cable interface - transmission
  (speed, length, data & power & sync …)
- Interface board - preprocessing
  (camera control & communication, Image formatting, pre-processing, host transfer rate…)

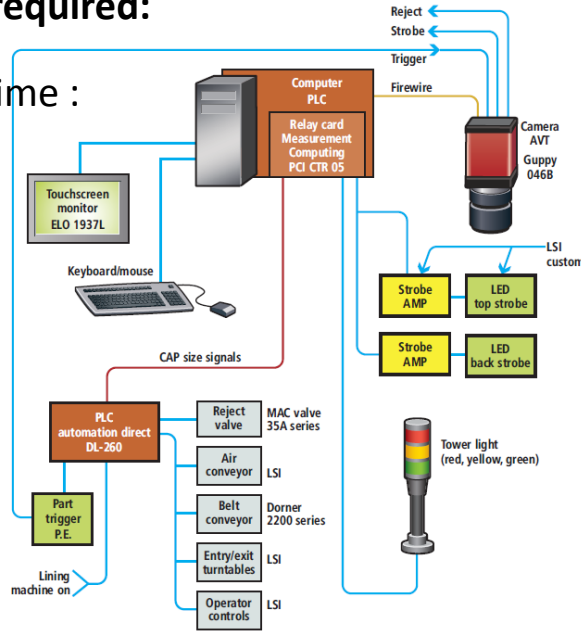


**Figure 2:** As each part enters the machine vision system, dome and backlights are strobed and an image of the part captured to a host PC. If a part fails inspection, a PLC is triggered by the camera that in turn rejects the part pneumatically.

// …and a proper application software will give best quality of analysis !



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# Machine Vision Systems – The different types

## Machine Vision Systems

### Smart Sensors

+

- Mostly compact, standalone
- High Price/Perf. ratio
- Ease of use
- *+++make the job*

-

- Remote mounting of PC
- Long cable required
- Design for specific usage
- Limited in model numbers

LMI

### Smart Cameras

+

- Capture & Processing Embedded
- Open for programming
- Cost effective vs PC based
- I/O included, Lighting sometimes

-

- Remote mounting of PC
- Long cable required
- Lack of # models (Resolution, Speed)
- Lifetime


Cognex

### PC based Systems

+

- Highly configurable
- Open to any interface
- Open to multiple cameras conf.
- Numerous software tools

-

- Highest cost
- Complexity
- Maintainability - Lifetime

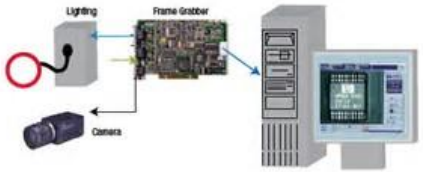


Figure 1 Computer-based Machine Vision System.

### Vision Appliances

+

- Hybrid of PC-based & SmartCam
- More power than SmartCam
- Multiple camera conf. (ie. max 4)
- Windows or RT OS with Easy GUI
- I/O included

-

- Dedicated and proprietary design
- Most of time dedicated cameras
- Lifetime

NI

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# Machine Vision Systems – The different types

Machine Vision Systems

## Smart Sensors

+
- Mostly compact, standalone
- H
- E
- +

-
- R PC
- L
- Design for specific usage
- Limited in model numbers

SALE PRICE 1-10k€

LMI

## Smart Cameras

+
- Capture & Processing Embedded
- Op g
- Cc ased
- I/C sometimes

-
- Re C
- Lo
- Lack of # models (Resolution, Speed)
- Lifetime

SALE PRICE 2-5k€


Cognex

## PC based Systems

+
- Highly configurable
- Op
- Op eras conf.
- Nu ools

-
- Hi
- Cc
- Maintainability - Lifetime

SALE PRICE 5-15k€

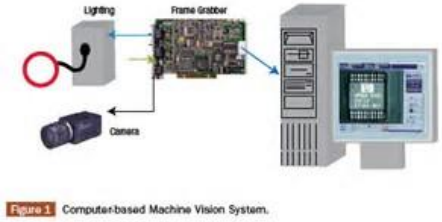


Figure 1 Computer-based Machine Vision System.

## Vision Appliances

+
- Hybrid of PC-based & SmartCam
- More cam
- Multi . max 4)
- Wind asy GUI
- I/O ir

-
- Dedic y design
- Most of time dedicated cameras
- Lifetime

SALE PRICE 3-7k€

NI

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# Develop your own Smart Camera – Status

// Smart Cameras are delivering the right Price/Performance ratio for a lot of applications either for:

- Distributed architecture
  - Each are focusing on one task and report to one main host device for management and statistics.
- Standalone/sensor context
  - Camera is one of many devices with Go/NoGo or limited output data (OCR – Presence/absence)
    - *(only Failed/Bad are interesting information's or just the result - e.g.: Barcode, Profile, Position…).*


First Allied Vision Smart Camera in 2002


Adlink

Cognex

Newer Smart Cameras and Smart Sensors available on the market



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# Develop your own Smart Camera – Why ?

| Reasons to choose | ☹😐😀 | Your applications needs! |
|---|---|---|
| Size or form factor | | Actual Smart Camera won't fit, special form factor is requested |
| Choice of sensors/cameras | Yes | Available list of potential sensors or cameras you could use now and later |
| Leaving MS Windows | | You need a long life OS, Linux is an option or maybe your own BSP |
| Specific features | | Sequential storage - Multiple running average - Power consumption, … |
| Dedicated algorithms | | Special IP Algo. with your own knowledge to integrate (Deep Learning, 3D,…) |
| Communication links | Maybe | Bluetooth, Wifi, CAN, Ethernet, RS232-422, … |
| I/O's | | Triggering, strobing, ejecting signals but much more to integrate |
| Long time availability | | Certifications needs or long term development secured by best suppliers |
| Maintainability | | Own design, means easier hands on for maintenance |
| Cost | No | Need exact list of functionalities, not less not more and at a lower price |
| Unique & Proprietary design | | "Fade up" with copies of your application – this is an option to look after |
| Upgradability | | The design will need to follow the evolution of your client/Apps demands |

# Develop your own Smart Camera – Why now?

// Why should we think about it just now?


- New markets with high volume (Retail, UAV, Robotics, Medical, …)
- Portable devices for emerging countries are on high demand.
- New technologies trends (3D, AR, VR, Deep Learning,…)
- Processing power available on SoC, GPU, IPU or FPGA are now powerful and price is competitive
- ARM computer environment are easier to enter based on supported Linux OS (many communities)
- Overall cost of each components are lower than before, power consumption needs to be lower
- CMOS cameras are mature and easier to interface with multiple interface available



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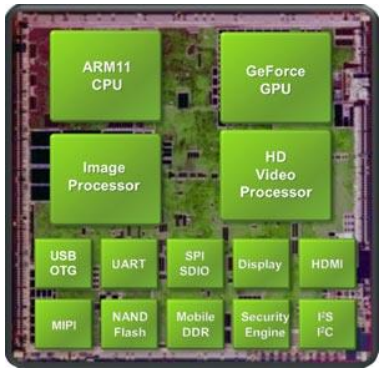
# Develop your own Smart Camera – How? Some Terminology

// What are the types of computer platform available for Embedded Vision?

- SoC (System On a Chip): Super processor (Mono, Dual or Quad Core) with GPU, Memory, Real World Interface (USB, PCI, Ethernet,…) and other devices all in one component package.

GHI Electronics




- SoM (System On Module): Also called CoM (Computer On Module) is an intermediate form factor including the SoC and Power management, more memory like DRAM and other bus systems. Mostly available within a standard form factor like COM Express, Qseven, ETX, SMARC.


Variscite



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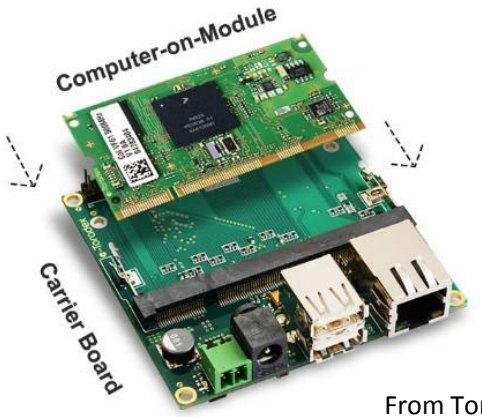
# Develop your own Smart Camera – How? Some Terminology

- SoM + Carrier Board: when you need direct connection with the peripherals like USB, Ethernet, Audio or HDMI for video, you then need more PHYsical connectors. This is the purpose of the Carrier Board which supports the SoM and creates the bridge to the outside world of physical devices.
- Easy to develop, this is also where you find most of the Open Source designs.




From Toradex

You can start to develop at that point.
SoM+Carrier or SBC

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# Develop your own Smart Camera – How? Some Terminology

- SBC (Single Board Computer): One board design integrating the SoC and the designer choice of peripherals. Raspberry Pi, Odroid XU4 & UP board are some well known examples of Low Cost SBC's.



- Customized Design: It is a cost-optimized design for a specific application where the form factor and the ratio cost/performance are the only goal. It is mostly an SBC design but could also be a SoM + Carrier board.




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# Develop your own Smart Camera – How?

// What are the software environments and tools available?

- Operating Systems: Windows 8/10/RT; Linux with Ubuntu, Yocto, Debian …and many BSP; Android; …

- Image Processing Tools: Open GL,  Open CV, Open VX are the ones mainly used
- Image Processing 3rd Parties Libraries: CVB Common Vision Blox, MaTlab, MIL, NI Labview, …

NATIONAL INSTRUMENTS · MATLAB · HALCON the power of machine vision · MERLIC · COMMON VISION BLOX · COGNEX vision · MATROX IMAGING · OpenCV · ab software · NORPIX · Adaptive Vision · SCORPION VISION SOFTWARE



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# Develop your own Smart Camera – How?


mipi


*Consumer World*

**No high quality machine vision sensors available!**
**It‘s for Consumer markets not for Industrial**



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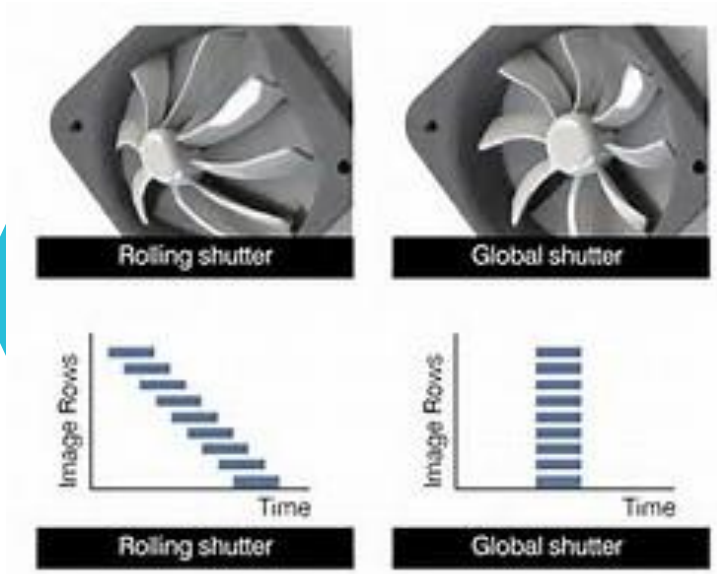
# Develop your own Smart Camera – How?


*Industry World*

We serve your needs

**Machine vision needs reliability, maintainability and long term availability**

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# Develop your own Smart Camera – How? With Vimba

// Allied Vision provides you with all necessary camera Software tools for your embedded applications with our Vimba SDK.

Windows


https://www.alliedvision.com/en/products/software.html



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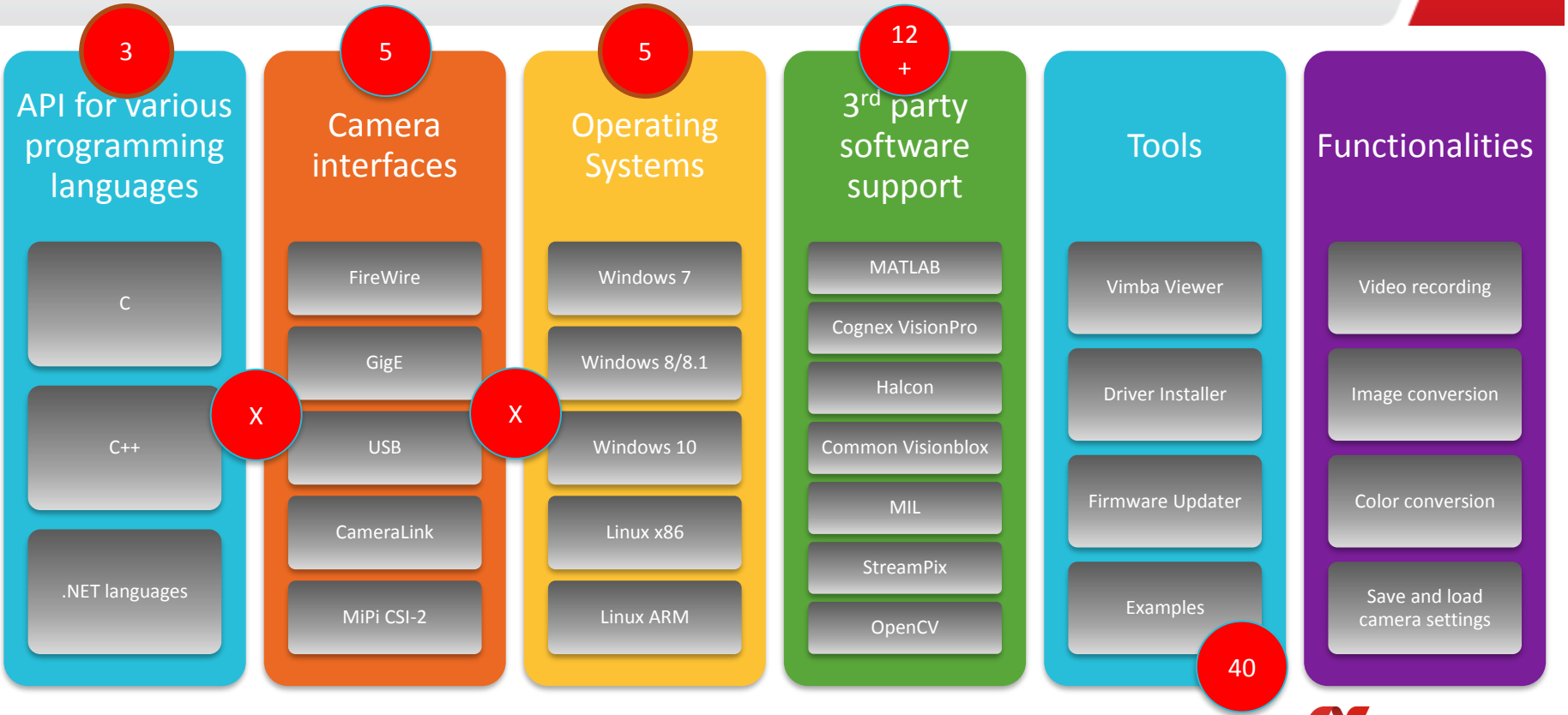
# Develop your own Smart Camera – How? With Vimba



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# Develop your own Smart Camera – How?

// So now what are your needs?

- As stated before:
  - Defined your required specifications in term of Price/Performance ratio
  - Operating systems (Windows, Linux, Androïd, RT kernel,…)
  - Chose your processing power ( CPU, GPU, …) and memories (SRAM, DRAM,…)
  - What type of cameras (resolutions, speed, interface, features,…)
  - Peripherals (I/O's, Communications, Storage,…)

**→Start with the adequate Development Kit (*The one having more than all you need*)**

# Develop your own Smart Camera – How?

// Once having successfully developed your application based on the Development Kit,

- It is time to make the next step …

  → Choosing the adequate SBC or SoC-Carrier board design supporting the application.

// Make a final list of the necessary memories, type and numbers of peripherals to define your minimum requirements

- *Then define the maximum size and shape for your hardware (taking care of the heat dissipation too → custom case to design !)*

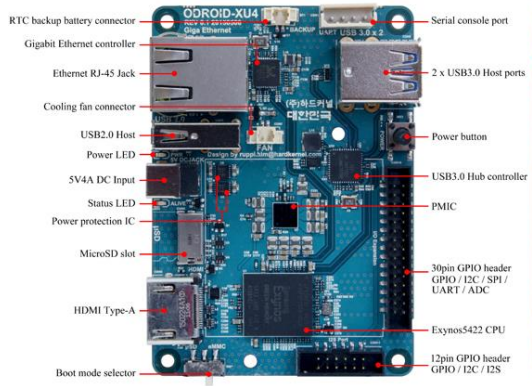
- Does the carrier board already exist on the market ?
- **OR** do i need to design a custom one for my application ?

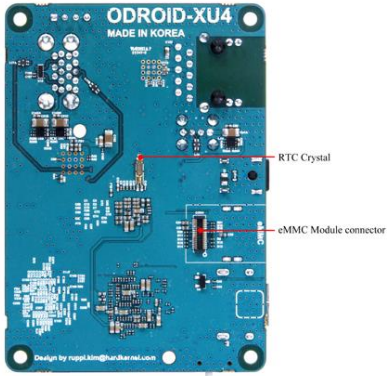
# Develop your own Smart Camera – Few Examples

// Some quick examples follow to show the variety of solutions from Low cost to STD Embedded Solutions

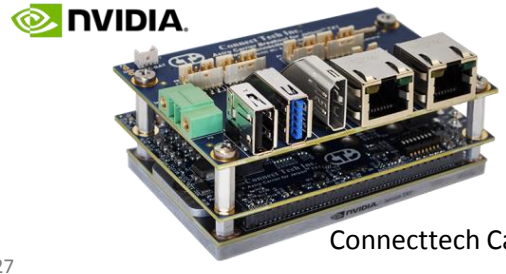

Orange Pi
Zero Plus 2

Boundary Devices – Nitrogen 6 max




Odroid XU4




Connecttech Carrier



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# Develop your own Smart Camera – Few Examples

// It’s time to think SMART !

**Price/Performance ratio**


**Embedded Design**

**Upgradability**



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# Develop your own Smart Camera – 1st Example

// AEEON – UP Core board

- SoC Intel Atom x5-Z8350-Quad Core-1,92GHz CPU
- Intel HD 400 Graphics Engine
- 2GB/4GB RAM – 16/32/64GB eMMC
- 1x MiPi-CSI 2 lane, 1xMiPi CSI 4 Lane
- Gigabit Ethernet Controller
- 2x USB2.0 + **1x USB3.0**
- WiFI 802.11 b/g/n & Bluetooth 4.0
- HDMI output for display
- 100 pins Docking (I2C/SPI/UART/PWM, GPIO…)
- Run under Linux Ubuntu, Yocto, Windows10
- Size 66x56.5 mm, 0-60°C,

* Microscope Image System, 5MP mono with WiFI communication


// Allied Vision – Mako-USB 3.0

- Onsemi Aptina 2588x1940
- 15 fps max – Rolling Shutter



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# Develop your own Smart Camera – 1st Example

~Budget for :

*Board 4GB/32GB eMMC
*Windows 10
*Camera
*Cables
*Power supply

SALE PRICE
650€

* Microscope Image System, 5MP mono with WiFI communication


// Allied Vision – Mako-USB 3.0
- Onsemi Aptina 2588x1940
- 15 fps max – Rolling Shutter



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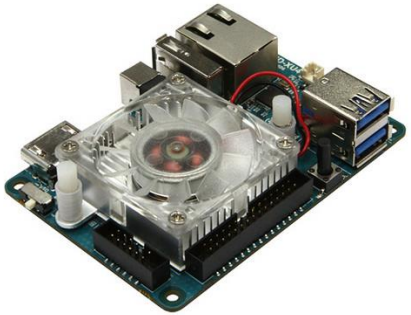
# Develop your own Smart Camera – 2nd Example

// Hardkernel – ODROID XU4 SBC

- SoC Samsung Exynos5422 – 8 core
  - 4x CPU Cortex-A15 @ 2.0GHz
  - 4x CPU Cortex-A7 @ 1.4GHz
  - 1x GPU Mali-T628
  - 2GB LPDDR3
- SD slot and eMMC option (8-64GBmax)
- Gigabit Ethernet Controller
- **USB3.0 Hub controller + 2 ports**
- 2x USB2.0
- Serial Console port
- HDMI output for display
- 30 pins GPIO (I2C/SPI/UART/ADC…)
- Run under Linux Ubuntu
- Size 83x58x22 mm

* Machine Vision measurement triggered system at 5 fps, 1.3MP resolution monochrome




// Allied Vision – Mako-USB 3.0

- Onsemi Python 1280x1024
- 15 fps max – Rolling Shutter



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# Develop your own Smart Camera – 2nd Example

~Budget for :

*Board 2GB/16GB eMMC
*Linux uBuntu
*Camera
*Lens
*Cables
*Power supply

SALE PRICE
590€

* Machine Vision measurement, triggered system at 5 fps, 1.3MP resolution monochrome


// Allied Vision – Mako-USB 3.0
- Onsemi Python 1280x1024
- 15 fps max – Rolling Shutter



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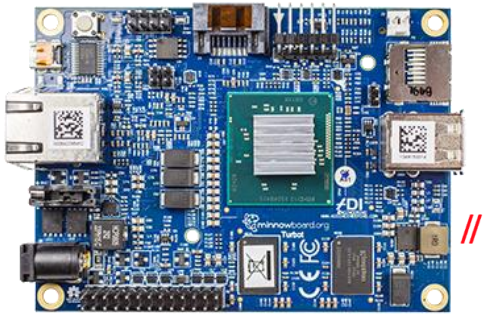
# Develop your own Smart Camera – 3rd Example

// MinnowBoard Foundation – Turbot « Open Source hardware »

- SoC Dual/Quad Core 64bits
  - Intel Atom E3826 (1.46Ghz) or E3845 (1.91Ghz)
- Integrated Intel HD Graphics – 2GB DRAM DDR3
- **1x Gigabit Ethernet Controller**
- 1x USB3.0
- 1x USB2.0
- 1x Sata2 (3Gb/sec), 1x MicroSD Card slot
- HDMI output for display
- High Speed Expansion interface (mPCIe/SATA, USB…)
- Low Speed Expansion (I²C, I2S, PWM, I2S, UARTs, GPIO's
- Run either Windows,Linux, Android, Yocto Project
- Size 99x74mm

* Compact DVR recorder for video inspection, VGA mono with Sata Direct to Disk storage




// Allied Vision – Mako-GigEvision

- CMOSIS 644x488 monochrome
- 309 fps max – Global Shutter



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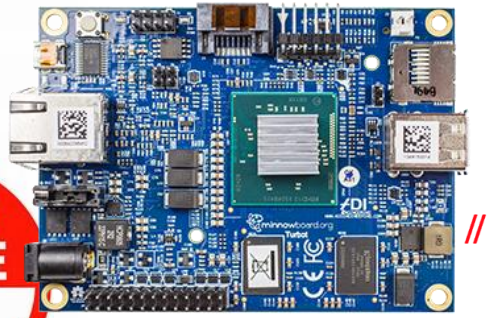
# Develop your own Smart Camera – 3rd Example

~Budget for :

*Board + HD 1 TeraOctets
*Windows 10
*Camera
*Lens
*Cables 10m
*Power supply

* Compact DVR recorder for video inspection, VGA mono with Sata Direct to Disk storage





// Allied Vision – Mako-GigEvision

- CMOSIS 644x488 monochrome
- 309 fps max – Global Shutter



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# Develop your own Smart Camera – How? Simply with us

// What Allied Vision will bring in 2018 to optimize your Embedded Design…

- Lowering the CPU load
- Deterministic interface with MiPi-CSI 2
- Specific and numerous features to work with
- More compact size for the camera block
  - One camera in board level form factor + housing if needed
- Lowering the heat dissipation
- Long term availability

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# Develop your own Smart Camera – How? Simply with us

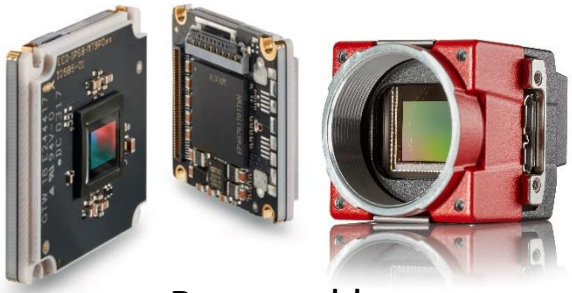
**ASIC** not FPGA

Low Power

HighTech now affordable

MiPi CSI-2

1 Product Line



Numerous Features

Modularity

USB 3.0

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Embedded Design

Long Lifetime

Ultra Compact



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# Develop your own Smart Camera – How? Simply with us

Camera interface comparison for the Embedded Vision World

| | CSI-2 D-PHY | USB3.0 - USB 3.1 | GigE Vision |
|---|---|---|---|
| Bandwidth | **Up to 2.5Gbit/s per lane<br>4 lanes up to 10GBit/s** | 5GBit/s | 1GBit/s |
| Cable Length | Up to 0.6m | Up to 8.0m | Up to 100m |
| Integration effort | High | Easy | Easy |
| CPU load on host | **Low** | High | High+ |
| Availability on embedded boards | **High** | Limited<br>(only high-end) | Limited<br>(only high-end) |



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# Develop your own Smart Camera – 1st Smart Idea

// Shenzhen Xunlong Software Co - Orange Pi Zero Plus 2 - « Open Source hardware »

- AllWinner Tech H5 SoC
  - CPU ARM Cortex-A53 Quad Core 1.2Ghz
  - GPU Mali450
- WiFi antenna & Bluetooth Com.
- **MiPi CSI-2 interface**
- 2x USB2.0 + OTG power supply
- 512MB DDR3 SDRAM
- 8GB EMMC Flash
- SD card slot (Max 32GB)
- HDMI, Tvout, IR Receiver, Mic, Earphone
- 26 pins GPIO (I2C/SPI/UART/ADC…)Raspberry Pi B+ compatible
- Run Linux Ubuntu, Debian, Raspbian, Android…
- Size 46x46mm – 36g

* IoT – Compact Lowcost snapshot color global shutter camera with WiFI & Bluetooth communication


// Allied Vision – 1 Product Line

- Serie 130 C-120 color M12
- ONsemi ARO135 1280x960
- 54 fps max – Global Shutter



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# Develop your own Smart Camera – 1st Smart idea

~Budget for :

*Board
*Linux Ubuntu
*Camera
*Smount lens
*Cables
*Power supply

SALE PRICE
199€

* IoT – Compact Lowcost snapshot color global shutter camera with WiFI & Bluetooth communication


// Allied Vision – 1 Product Line

- Serie 130 C-120 color M12
- ONsemi ARO135 1280x960
- 54 fps max – Global Shutter

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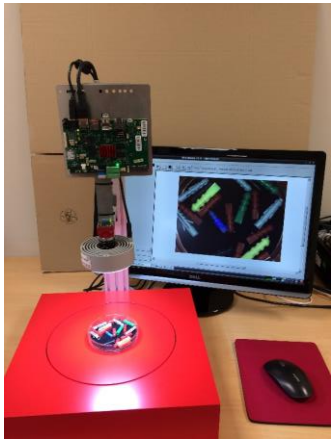
# Develop your own Smart Camera – 2nd Smart Idea

// Boundary Devices – Nitrogen 6 max – Intermediate Power Embedded Vision Proc.

- NXP iMX6 Quad Core ARM SoC
  - CPU Cortex A9 at 1.0Ghz + VFP + IPU
  - Integrated GPU by Vivante + H264/MPEG4
- PCI Express Port + Wifi 802.11 + BT
- 1x 10/100/1000 Mb Ethernet port
- **MiPi CSI-2 interface**
- 3x USB2.0 (2 Host + 1x OTG (OnTheGo)
- 4GBytes DDR3 + 2MB sFlash + 4GB eMMC
- SD card slot (Max 32GB) + Serial ATA
- 4x Display ports (PRGB, 2xLVDS, HDMI)
- RTC & I/Os (I2C/SPI/GPIO/2xRS232/RS485/CAN…)
- Run under Linux Ubuntu, Android, Yocto
- Size 137x87mm

* Multi-purpose Machine Vision Smart Camera Design with adaptive resolution & performance

// Allied Vision – 1 Product Line

- From VGA to 21Mpixels
- CMOS Rolling & Global Shutter

Allied Vision

# Develop your own Smart Camera – 2nd Smart Idea

~Budget for :

*Board
*SD32GB + HD250GB
*Linux Ubuntu
*1x Camera
*S/CS/Cmount lens
*Cables
*Power supply

SALE PRICE 399€

SALE PRICE 1499€

* Multi-purpose Machine Vision Smart Camera Design with adaptive resolution & performance

Allied Vision

1 Product Line

// Allied Vision – 1 Product Line

- From VGA to 21Mpixels
- CMOS Rolling & Global Shutter

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# Develop your own Smart Camera – 3rd Smart Idea

// NVIDIA – Jetson TX1 – Embedded Power Development Kit

- Tegra TX1
  - CPU ARM Cortex-A57 Quad Core (1.73Ghz) Neon Technology
  - Maxwell GPU 256 Core
    - With (Open GL|Vulkan|DirectX|CUDA 7.0|GPGPU|…)
  - Image Signal Processor + Display Controller + Security +++
- Encode & Decode H264/H265/JPEG/MPEG decode only
- **MiPi CSI-2 interfaces (support for 3 x4lane or 6 x2-lane camera)**
- 3x USB3.0 & 3x USB2.0 + WiFi and antenna
- 4GB LP DDR4 SDRAM
- 1x Gigabit Ethernet port (thru USB bridge)
- SD card slot + eMMC + 1x SATA port
- 2 independent Display output (HDMI|DP1.2a) & (MiPi-DSI|eDP1.4)
- 5 lane PCI express (one x1 & one x4 controllers) + 4 UART + 3 SPI + 6 I²C + …..
- Run under Linux Ubuntu
- Size 175x175mm

* 360° viewing and streaming system with TX1 and 1 Product Line




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# Develop your own Smart Camera – 3rd Smart Idea

~Budget for :

*Jetson TX1 Board
* SDcard + 64GB eMMC
*Linux Ubuntu
*6x Cameras
*6x Lens
*Cables
*Power supply

SALE PRICE
995€

* 360° viewing and streaming system with TX1 and 1 Product Line




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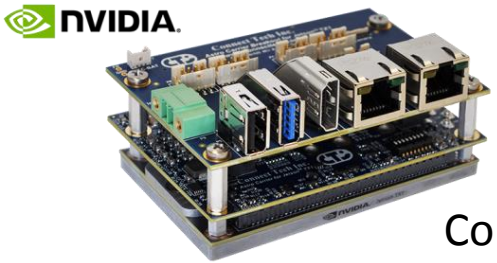
# Develop your own Smart Camera – 3rd Smart Idea

- NVIDIA JETSON Tegra TX1 & new TX2 are the most powerful compact computer so far for AI and Video Processing.
- This hardware computer solution will be the best to choose for multiple camera interface with MiPi CSI-2 up to 6 cameras *(be carefull with the supported resolution and frame rates).*
- OpenCV and OpenVX and CUDA are available and mostly use for designing high level applications on NVIDIA JETSON
- Auvidea and Connect Tech. are the two principals NVIDIA Jetson carrier boards manufacturers with multiple solutions off the shelf to accelerate the time to market for new applications.




Connecttech

Auvidea



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# Develop your own Smart Camera – Last Smart Idea ?

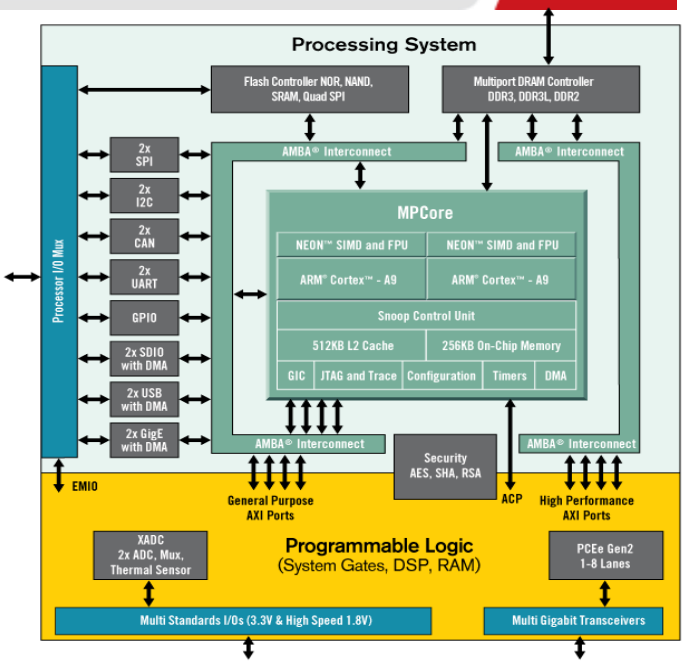
THE ULTIMATE SOLUTION could be to design all in one FPGA

// Xilinx Xynq FPGA or Intel Altera Aria 10 solutions (examples)

// Going further with embedded vision

→Combined power of FPGA's and Dual/Quad Core ARM Linux.

***Need more expertise and volume to support design cost overall***


Any Allied Vision camera
with CSI-2, USB3, GigEvision and VIMBA for SDK



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# Develop your own Smart Camera - RESUME

// Take the time to evaluate your needs

// Precisely study your specific requirements

// Pro's & Con's : Make the two list of advantages and disadvantages of the chosen solution

// Economic study : Calculate the ROI (Return On Investment)

// Life Time : how long I will need this type of architecture

- Is it evolutive enough for my potential apps?
- SBC or Soc+Carrier board life time?
- Camera life time (No problem with Allied Vision ALVIUM® – It is our own design and component).



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# Develop your own Smart Camera – Simply with us

## // Allied Vision is unique for Embedded Vision…

- We provide cameras with different interfaces
  - GigEvision, USB3 vision, Cameralink, Coaxpress and the new MiPi-CSI2 for embedded
- We deliver long time reliability and best performance/price ratio
  - GigE Vision, USB3.0 and MiPI-CSI2 are the interface for Embedded Vision
  - We offer cameras from Compact cube form factor to High resolution and High Temperature range
  - Lots of innovative features embedded in our new ASIC – “Unique on the market”
  - MiPi CSI-2 takes 30% off CPU load than USB3.0 →this is absolutely to consider in Embedded Vision
  - We offer the best Global shutter sensors Roadmap on the market (Sony, ONsemi, CMOSIS, E2V, …)
  - We have a clear future and we preserve your investment with the best Price/Performance ratio offer
  - Our VIMBA SDL toolkit help you to easily migrate your application (OS – Interface – Camera Families)



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# Develop your own Smart Camera – Simply with us

// Allied Vision is unique for Embedded Vision…


**→Start with us to make your life easier**

**→Use our MAKO, MANTA and GT families for your Embedded Design**

**→Plan to optimized your entry level design with our 1 Product Line**

**→Just ask us to visit you and let's share our common ideas**




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# Any Questions ?



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# Thank you!

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