



Smart Cameras: Terms and Trends

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Digital vision is a relatively new technology that advanced dramatically in the last 10 years. The latest generation of vision systems has been dominated by the rapid evolution of Smart Cameras that in many cases combine the intelligence of PC with the image quality of a high end industrial camera. This presentation will explore current and future trends in Smart Camera technology. It will also discuss Smart Camera benefits and limitations compared to PC based vision systems.

Main Points:

Definition of the term "Smart Cameras" compared to other types of vision systems or imaging devices such as smart or expert sensors, framegrabbers and PC based vision systems.

Latest trends in Smart Camera technology including advancements in CPUs, processing devices, operating systems and interfaces.

Smart Camera benefits and limitations compared to PC based vision systems. In the process of comparing the two, criteria such as performance, system architecture and cost effectiveness will be discussed.

Contents

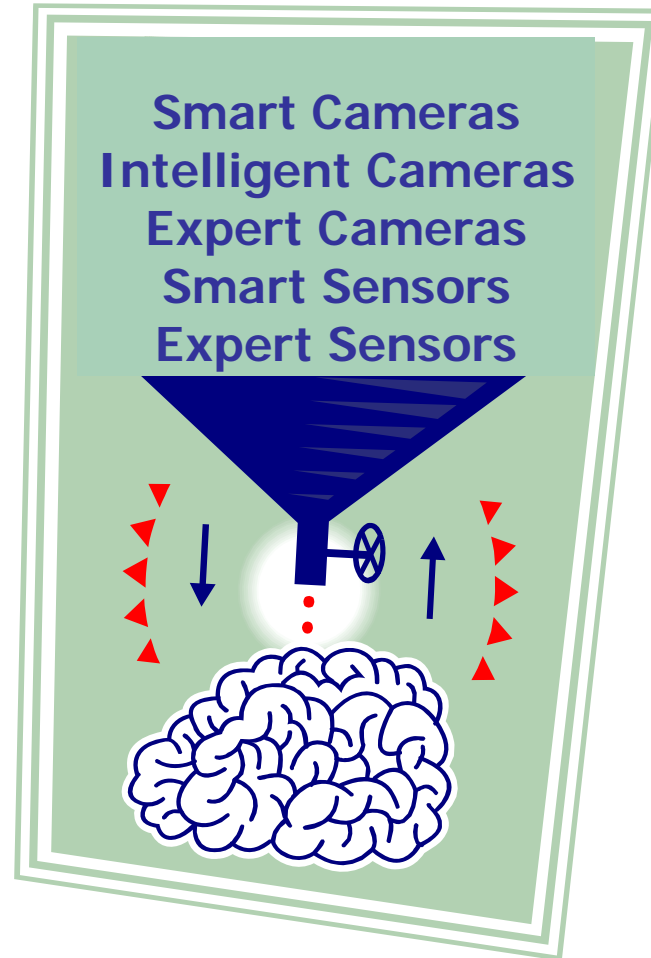
- Overview of smart cameras compared to frame grabber and PC host processing alternatives
- Capabilities and limitations of smart camera technology
- Overview of smart camera types
- Smart camera technology trends

PC Host Vision System

- Consists of PC, capture card and camera
- Many options for each component
- Multiple cameras per PC
- Windows or Linux based vision libraries



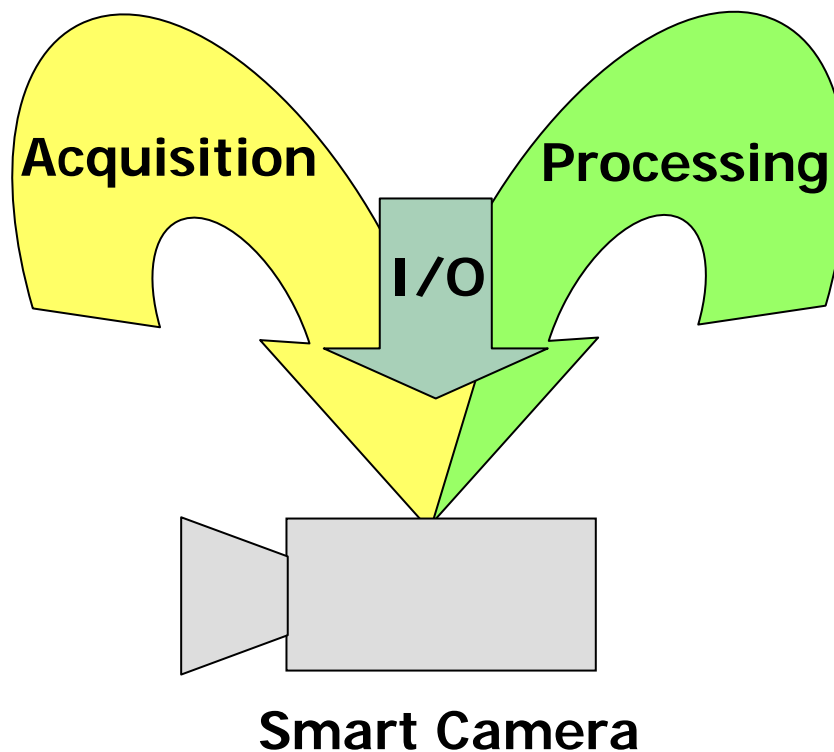
"Buzz Words"



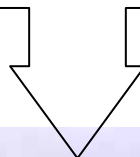
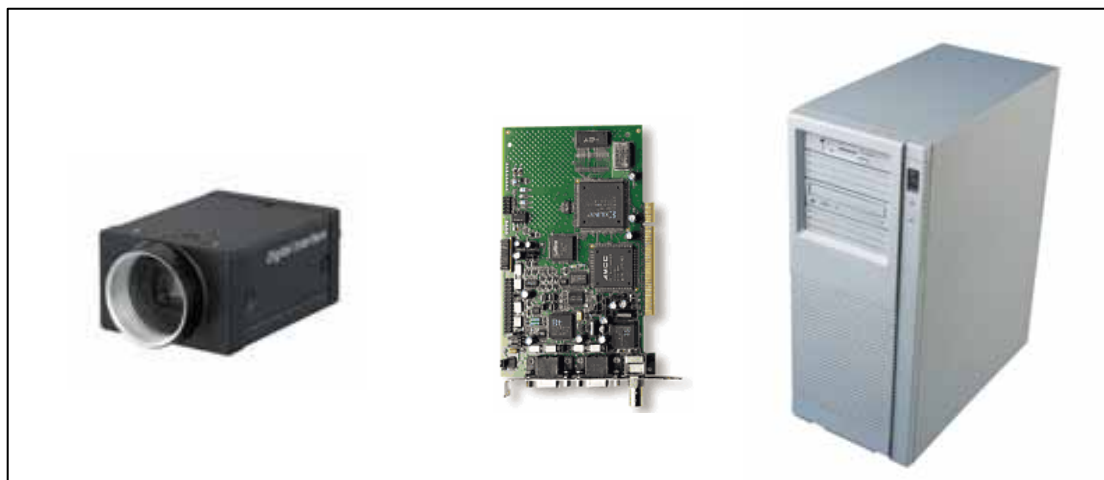
What is a “Smart Camera”?

- Camera companies have been adding features such as programmable hardware components and I/O
- “Smart” or “Expert” sensors are built to perform very specific tasks in a cost effective way
- However in both cases, these products do not have the functionality of a complete vision system

Smart Camera: Compact Vision



Smart Camera: Compact Vision



"Smart" Capabilities

- Potential to perform all functions of a complete machine vision system:
 - Measurements/Alignment
 - Pattern recognition
 - ID reading
 - Surface inspection
- Fit in tight places
- Easy to use

“Smart” Limitations

- Processing capabilities
- Extreme applications:
 - Acquisition speed
 - Very high resolution
- Extended I/O requirements
- Less cost effective if design includes multiple cameras per machine

Why Smart Cameras?

- Ease of Use
 - Simple application development
 - Easy deployment
 - Adaptable for future changes
- Low Maintenance
- Compact and rugged form factor
- Low cost

Direct Cost Comparison

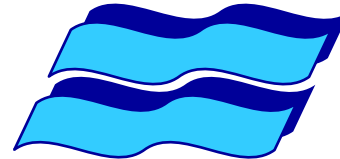
PC Host Vision System

- PC: \$1,000
- Framegrabber: \$500
- VGA digital camera: \$800
- Software: \$1,500 to \$7,000
- Total: \$3,000 to \$8,000+

Example

VGA Smart Camera

- \$2,000 - \$5,000



Indirect Cost Comparison

Quality Smart Cameras offer:

- Simple development
- Simple deployment
- Easier maintenance
- Adaptability



Criteria for Success

- Accuracy
- Software reliability
 - Repeatability
 - Minimal number of false positives
- Hardware reliability
- Acquisition and processing speed
- Ease of use
- Flexible and adaptable solution
- Support

Smart Camera Types

Smart cameras are built using:

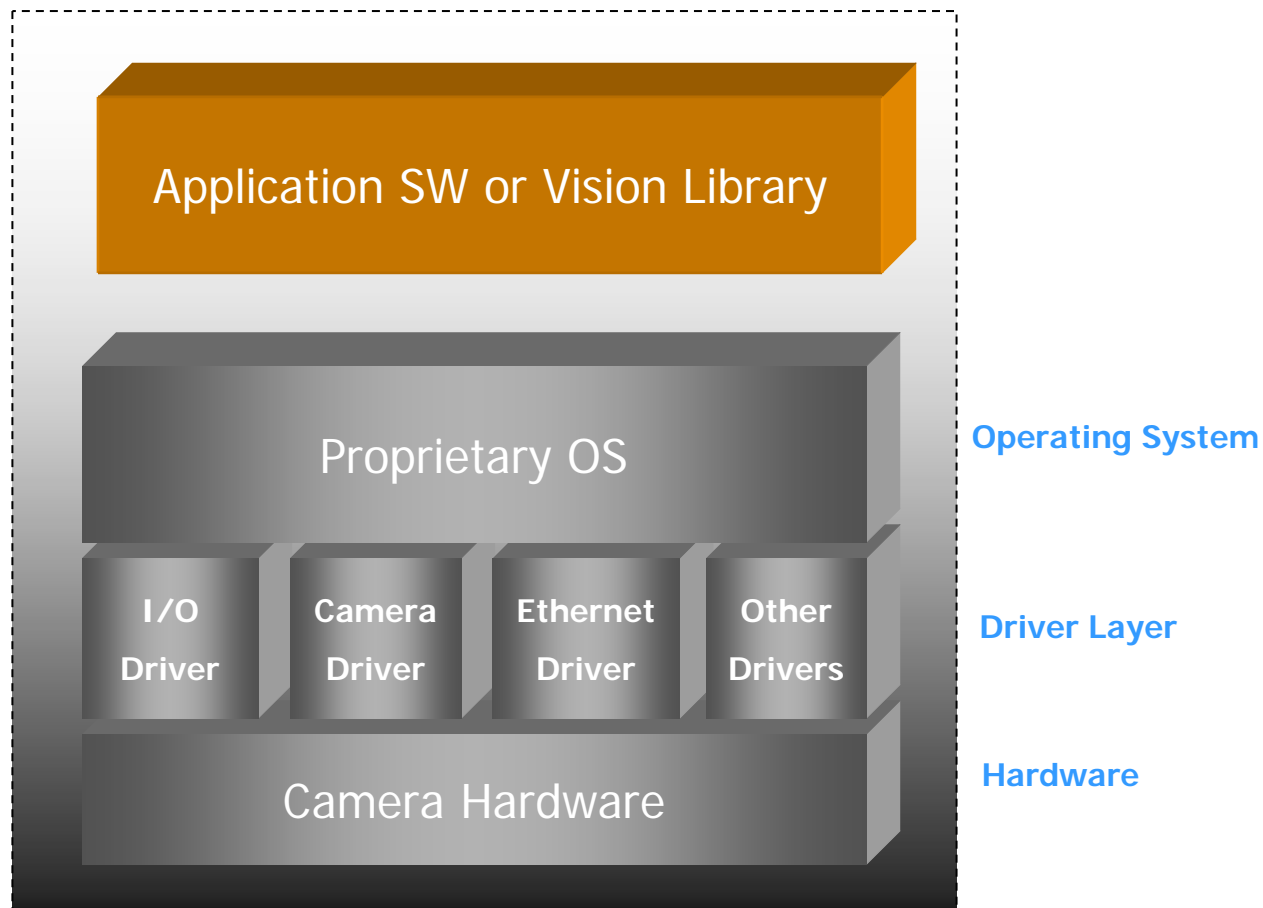
- Processing
 - DSP
 - Proprietary processors
 - X86 CPU
- Operating System
 - Proprietary
 - Linux
 - Windows

Smart Camera Types

Smart cameras are capable of running:

- A single application software
- A single vision library
- A variety of vision libraries or custom software

Smart Camera Types



Open Architecture

Options for 3rd party vision libraries or
user developed software

Application & Library
Layer

Windows XPe or Linux

OS Layer

I/O
Driver

Camera
Driver

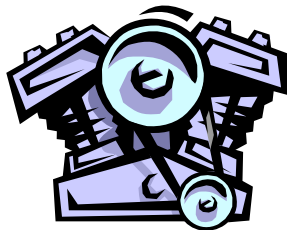
Ethernet
Driver

USB
Driver

Driver Layer

Camera Hardware

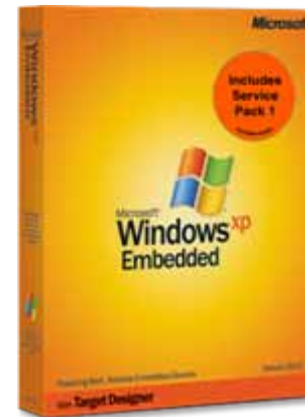
Hardware



X86

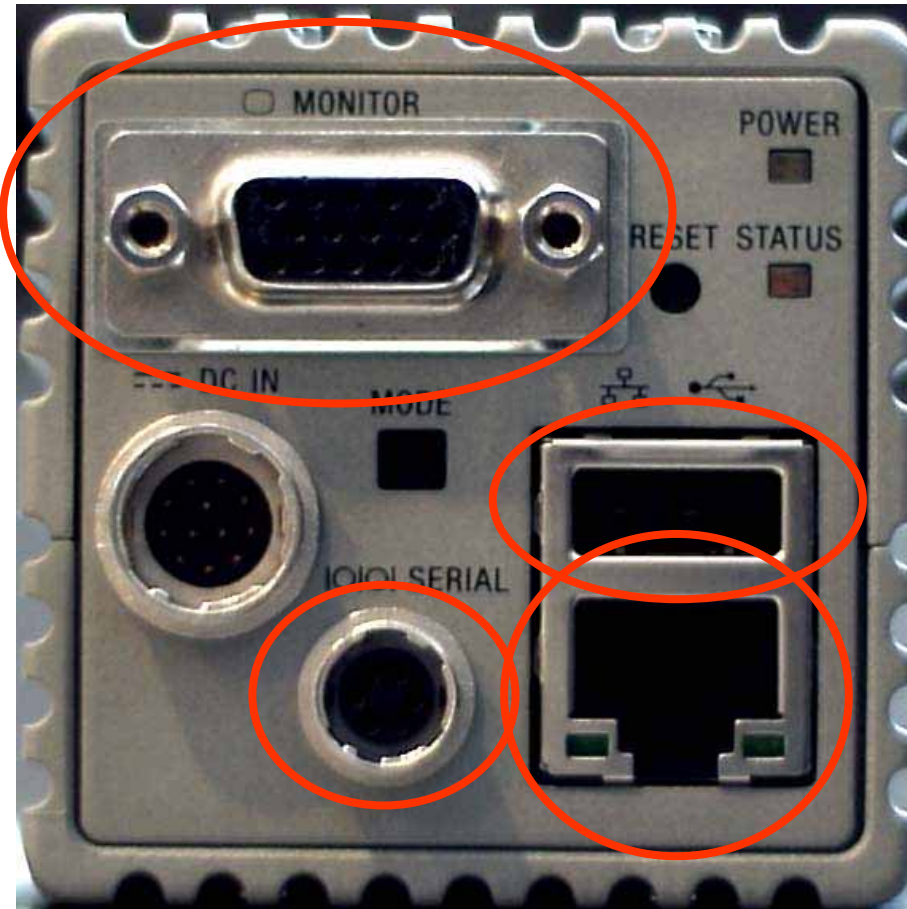
Why XPe?

- Componentized Windows® XP Pro
 - Performance
 - Reliability
 - Customization
 - Security
- Embedded-enabling features
 - Device Update Agent
 - Hardware analyzer
 - Deployment
- Powerful authoring tools
 - Component Designer
 - Target Designer
 - Component Database Manager



**Vast majority of vision developers
are familiar with MS platforms**

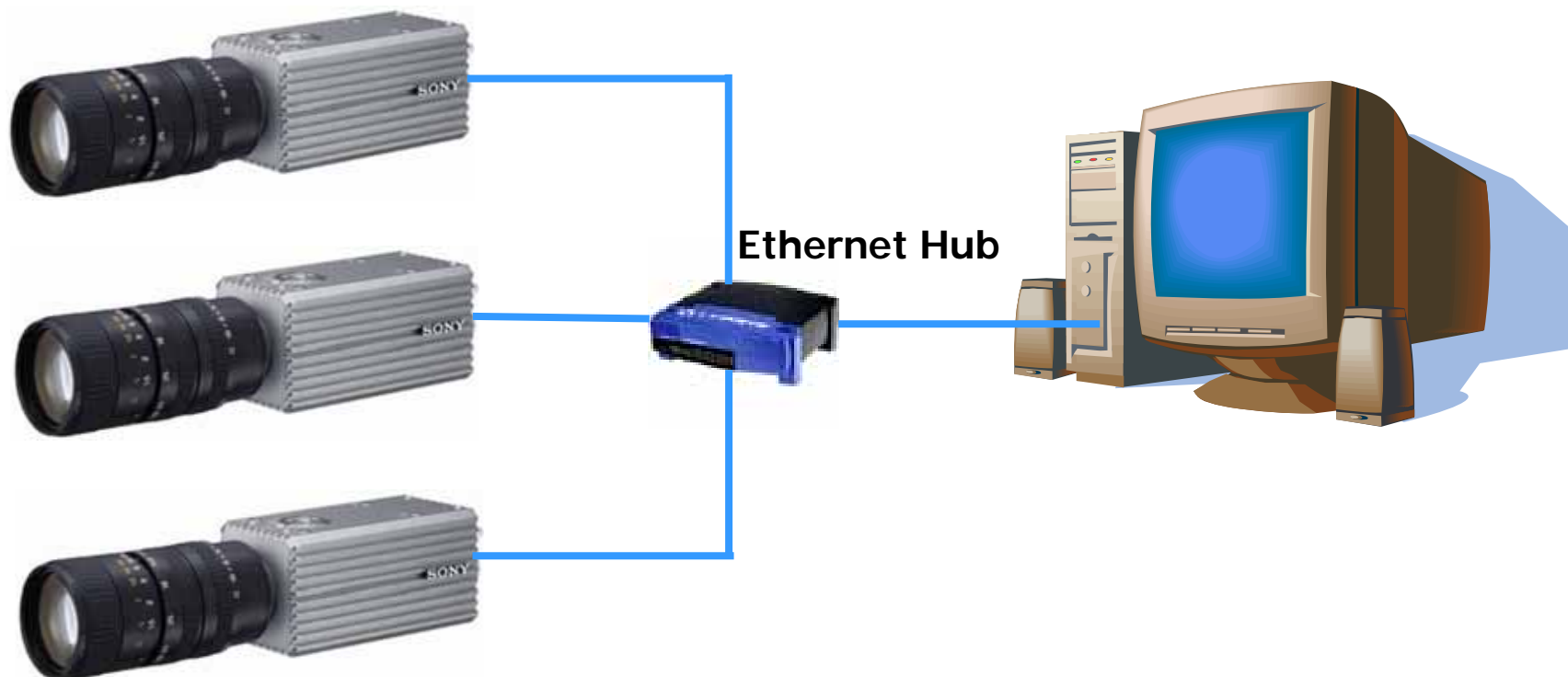
Connectivity



All-In-One Unit



Networking



SW Integration



SW Integration Options

1. Install application SW on cameras preconfigured with main stream OS
2. The customer is the developer and generates custom embedded OS file

Application SW could be 3rd party library or custom developed SW

Easy Installation

- Vision user powers up the camera and installs application like in the case of a PC running XP
- Easy way to evaluate a potential solution based on the Smart Camera

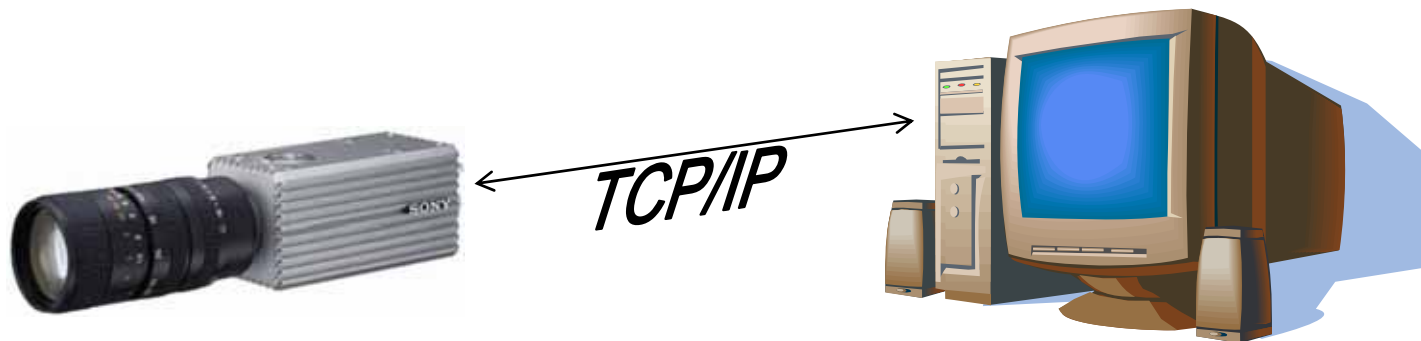


Option 1

Development Environment

Using MS Visual Studio 6 or Visual Studio .Net

- Develop on PC and compile/debug on XCI
- Develop directly on Smart Camera



Open Architecture

An existing software application running on Windows XP will run on XPe if:

- All software dependencies are resolved
- Camera driver is developed

Other Pros and Cons

- DSP and FPGA based products are optimized to run specific algorithms
 - Good for specialized tasks or demanding applications
- People are looking for solutions
- Majority of applications do not need exotic acquisition and processing performance

Smart Camera Applications

In addition to machine vision and robotic applications:

- Biomedical & Bioscience
- Security
- Traffic Control/Enforcement
- Event monitoring

Benefits of Open Architecture

- X86 CPU
- Options for Linux or Windows XPe OS
 - Main stream, programmable environment
- Monitor output and USB interface
- Ethernet
 - Complete industrial PC in a compact form factor

Who Benefits?

- End-users when the product is bundled with 3rd party SW
- SI/OEM that uses 3rd party vision library
- SI/OEM with in-house SW development capabilities that develops/ports own code

Smart Camera Technology Trends

- Higher processing capabilities
 - CPU roadmaps
 - Advanced DSP's and FPGA's
- Extended feature set
- Percentage of machine vision applications covered is increasing
- New markets
 - Surveillance
 - Biomedical

Conclusion

- Smart camera technology is perceived as the way of the future
- It is expected for this vision category to continue growing at higher rates than other types of vision systems
- Open architecture will expand usage of Smart Cameras in current applications and will also allow fast adoption of the technology in new fields

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