A Funeral Parade for the Frame Grabber?

INSPECT Expert’s Survey about the Future of a Component

GigE, FireWire, USB .... you can’t help but hear obituaries for the frame grabber from all directions. Has the concept of frame grabber outlived its usefulness? Is this component obsolete?

We think: no. And this is why we asked the experts “In which machine vision applications will the frame grabber continue to be needed and why is that so?”

Read on why from their point of view the frame grabber is not so easily passed by when demanding applications are concerned.

Dr. Reinhard Borst, Director New Technologies Eltec Elektronik

Eltec has been developing and manufacturing frame grabbers for many years already. When examining these closely, one can establish that a digital interface is usually a standard feature, whether with INDS, camera link or fiber-optics, and that image preprocessing in FPGAs is frequently already on the card. Nevertheless, analog interfaces are used if necessary, whether to permit the use of a high-performance CCD camera from a specific manufacturer or a special camera, e.g. for infrared.

Interface cards for connecting cameras are also required with Gigabit Ethernet if maximum performance is to be achieved with an acceptable CPU load, i.e. with more complex applications.

The strengths of frame grabbers – or let’s call them video interfaces – are to be found in applications with many cameras, high bandwidth and possibly with integral preprocessing. Technologies such as Ethernet and USB are not designed for this – special interfaces have always been required for such complex applications.

Michael Cohn, CEO Parameter

The frame grabber has previously primarily been used as analog to digital converter in a wide variety of applications. With today’s digital camera inter-
faces some of the more straightforward features in the frame grabber have moved into the camera. However, in the semi-conductor industry or other high-speed applications like print control, web inspection for paper, wood, steel or textile one often uses mixed camera types or high-speed cameras such as line-scan or TDI-cameras. To solve these applications you require absolute control of timing such as line synchronization and also management of the image data. This can still only be managed with a dedicated frame grabber.

In high-speed color analysis like food or fruit inspection the Bayer to RGB conversion is also preferably done in a frame grabber. Some cameras can do preprocessing in their FPGA, but typically speed decreases due to the increased bandwidth requirement of the RGBformat. In other demanding applications like military or medical applications, the required data reduction or image enhancement is best handled by dedicated hardware on the frame grabber.

The need to precisely control multiple cameras, dataflow and preprocessing will remain and also grow in applications with new digital camera interfaces.

**Dwayne Crawford,**
*Product Manager Matrox Imaging*

Despite the promotional campaigns for new digital interfaces, analog cameras still have a place in the vision market. The AIA’s studies continue to show that camera manufactures are selling analog units, and they’re selling a lot of them. Many OEMs continue to use these older technologies simply because they work well, are well understood and are still very cost effective.

In the future, complementary technologies will evolve, and they will bring with it larger, multi-core CPUs, higher bandwidth memories and interconnects. More demanding imaging applications will follow along. Once cameras with higher data rates and/or 3D and multi-spectral images become commonplace, interfaces and processors will be pushed to their limits. Frame grabbers will continue to be the vehicle to offload and allow these systems to handle the ever-increasing data rates and complex processing requirements.

The frame grabber might struggle in areas such as general manufacturing where the data rate is in the 10’s of MB/s. Ethernet or FireWire bandwidths are sufficient for this market as long as jitter is not an issue and the standard, inexpensive host PC has enough computing power to handle the application.

However, there are a lot of cameras available on the market that require a significantly higher bandwidth. These applications are currently only served by the CameraLink interface.

We also note that frame grabbers will remain a cost effective solution in even more applications. In the context of machine vision applications, using an IEEE1394 or GigE Vision camera may not require a „frame grabber” card per se, but still requires an interface card. „Traditional” frame grabbers, which are nothing else than interface cards dedicated to cameras, always provide valuable added functionality such as digital I/O lines that make them a cost effective solution. In the context of video surveillance applications, where dozens of cameras (16, 32, 64) have to be connected to a single PC, they are still the only affordable solution.

**Marc Damhaut,**
*VP Product Management Euresys*

Frame grabbers will typically continue to be needed in applications that require a high bandwidth. It can be because of the resolution or frame (or line) rate of the camera such as for PCB inspection or it can be due to the number of cameras involved such as for flat panel display inspections for example. In the context of machine vision, IEEE1394 and GigE Vision interfaces typically provide a bandwidth of less than 100 MB/s per port.

**Uwe Furtner,**
*General Manager Technics Matrix Vision*

The charm of standard interfaces like USB and Gigabit Ethernet lies in the usage without additional interface boards. Given that FireWire could not become accepted as a standard interface in the PC world, this advantage does not apply here. The interfaces have in common that the used bus structure leads to latency, which excludes usability in many Machine Vision applications.

As soon as shorter reaction times or high data rates are requested, interfaces like CameraLink come into operation, which guarantee transfer rates up to 680 MB/s and an almost latency-free transfer via correspondent grabbers. Applications can be found in areas like quality control, textile industry, technology (e.g., inspection of LCD panels) or printing industry. Systems in the security area often consist of several hundreds of cameras. Here, grabber based solutions with analog cameras offer a considerable price advantage.
Matrix Vision will be represented with suitable solutions also in the future, which can be seen, for example, in the current frame grabber development for multicore processors.

Inder Kohli, Product Manager Dalsa

Diversity in machine vision applications is fuelling the evolution and adaptation of frame grabbers despite the emergence of frame grabber-less image capture modalities such as GigE Vision, IEEE 1394a/b, USB2 etc.

The CameraLink, a dominant standard using frame grabbers, continue to evolve and progress. With CameraLink it is not only possible to go beyond 680MB/s on one hand but also provide one cable light-weight miniature cameras solution with PoCL/PoCL Lite on the other.

Due to their heavy dependence on the host CPU to reconstruct packets into usable images, standards such as 10GigE, when adopted for machine vision, will also require hardware assistance regardless of what this hardware is called. Increased data rates when combined with other operational requirements such as determinism, processing time, form factor, heat dissipation etc. benefit from frame grabber’s versatility and adaptability.

Frame grabbers are tightly integrating external controls with image capture, re-translation and preprocessing tasks. For example, it is now possible for frame grabbers to convert Bayer images into RGB, L*a*b, YUV or HSV etc. while transferring the original image to the host memory in real-time and with zero host CPU utilization.

Helmuth Oberpaul, Managing Director Cosyc

In the area of High Speed Video Recording we are facing typical data rates from 100 MB/s up to 1 GB/s. These data rates are not handled by mainstream camera solutions. Future tasks in research (rocket launch, film scanning and recording from vehicles like helicopter, airplane and cars) need cameras exceeding today’s specs regarding sensitivity, resolution and frame rate. Some applications require recording from two or more cameras simultaneously. Only frame grabbers with special features will be able to
meet tomorrow's requirements. Today's hardware solutions include CameraLink frame grabbers with PCI-Express interface as well as SD-SDI/HG-SDI featuring on the camera side and PC-Card Express Interface on the computer side (laptops) as well as frame grabbers with direct connections to disk arrays.

We did an exciting installation at the MPI in Garching. The system collects videos from a Photron camera with the resolution of 1,024 x 1,024 pixels at 1,000 fps at 10 bits grey level. Nonstop recording over 30 minutes. For this system we used two frame grabbers with Full CL interfaces each - and we see an increasing demand in performance in all areas of applications.

Alfons Bieden, Sales Manager SVS-Vistek

Appraising the importance of frame grabbers in today's market situation we have to differentiate: The low-end is either substituted by non-card based interfacing technologies like FireWire and GigE, or low cost products from Asia are applied; this means its importance is decreasing constantly. Wherein in applications of the high-end level frame grabbers are used frequently. However, these frame grabbers must meet the client's requirements for a fast and easy to install data transfer between the camera and the PC.

Especially the demand for new developments like PCIe and PCI-E compatible boards, and products with on-board processing units is very high. Applications with an extreme need of processing power in optical metrology or print inspection thus can be relieved from routine jobs like shading correction or Bayer Pattern interpolation. New applications in the fields of traffic monitoring or surveillance demand for use of frame grabbers with numerous analogue inputs and the possibility to receive compressed and uncompressed data streams simultaneously.

For the connection of industrial cameras with GigE interface more and more GigE frame grabber cards with several inputs and on-board processing power are available.

Georg Schelle, Sales/Product Manager Image Acquisition Stemmer Imaging

Frame grabbers are harder to justify in simple inspection tasks. Nevertheless, in the growing field of high-end and high-speed applications in the future it will be hard to solve these applications without a frame grabber. Line scan camera applications which need perfect timing and interaction of all components to work adequately are just one example of that.

In complex tasks such as solar panel inspection, print inspection or postal automation, a perfect synchronization between shaft encoder, lighting, cameras, frame grabber and software is not enough. Due to the high demands on the processing, certain tasks have to be solved separately.

The solution of choice here is to use the FPGA that is integrated on many frame grabbers for image pre-processing. Possible tasks are e.g. color space conversion, filtering, equalization and...
compression. Based on that, a dramatically increased processing capacity can be combined with the CPU/GPU even for the most complex image processing tasks. Without a frame grabber, this will remain impossible for the foreseeable future.

Tiny Trace Detection at High Speed
A major pharmaceutical manufacturer relies on Cognex In-Sight vision as part of their inspection machines designed to inspect small vials containing serum as well as detecting even the tiniest impurities within the serum. The In-Sight 5503 proves the only solution for this kind of sensitive high-speed inspection. IFP Ingeniería is based in Barcelona in Spain and manufactures special machines designed for high profile industrial customers. Praesens Kabi needed a special machine capable of tackling the challenge of inspecting small vials of serum. IFP provided them with a machine equipped with In-Sight vision systems from Cognex as recommended and integrated by Cognex partner, Edge Vision. In this application, In-Sight cameras were installed to inspect the levels of liquid in vials of serum as well as inspecting for impurities at a speed of 10,000 bottles an hour.

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Significant Efficiency Increase
Irsa Vision is now offering special in-line inspection solutions that allow customers to increase efficiency even more in various segments of the growing solar industry. Formscan-Solar provides a system that makes solar parabolic mirror inspection faster, easier and more precise. These inspections will lastingly benefit energy output, increasing it significantly. Powerscan enables thinfilm solar cells to be inspected efficiently and precisely in an automated process. These inspection systems can be employed throughout various production steps. They optimize the production process, increasing productivity. Manufacturers of solar plants thus achieve high returns on their investment almost immediately. Even in the current 2008/2009 fiscal year, Ilsa Vision is expecting significant sales from the new inspection systems for the solar industry.

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Matthew Slaughter, Vision Product Marketing National Instruments

Higher Scanning Speed
At the Technology Forum on 11 and 12 February 2009, Viscom will present its successful QuickScan soldier paste inspection on a new system platform, the S3088-II QS. The proven special illumination has been integrated into the system S3088-II, along with a new camera technology. Until now, the S3088-II has been offered as a post-flow AOI with 8M camera technology. Now Viscdom exploits the advantages of this system platform for 2-D solder paste inspection as well. The integration of a new camera head especially for paste inspection and a new high resolution line scan camera results in a scanning speed increase of up to 50%. This combination yields cycle times even lower than those achieved by the predecessor model. Customers who already employ a S3088-II post-flow also profit from synergistic effects during service and maintenance.

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Color Inspection and Grey-scale Machine Vision

With the Imagechecker AX40, Panasonic introduces for the first time a Machine Vision system which can process gray value images and color images at the same time. This opens new inspection possibilities, because the information given by colors is an important additional image evaluation feature. Thus, e.g., grey value measurements can be combined with an object-recognition in the color image. In addition, a special differential-image mode is available. It is suited particularly for surface inspection and print controls. The software of the AX40 offers all common inspection algorithms of grey value systems and color inspection systems. In total approximately 3,500 inspection combinations are possible. With this scope of so called checkers, the device is suited for virtually all inspection tasks such as assembly control, product differentiations, measurements or print control.

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