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 hearing 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 closelyt one can establish that a digital interface is usually a standard feature, whether with LVDS, 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 interfaces some of the more straight forward 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 band-width requirement of the RGB-format. 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 using cameras with the 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 handwidth 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.

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, IEEE 1394 and GigE Vision interfaces typically provide a bandwidth of less than 100 MB/s per port.
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 cam-

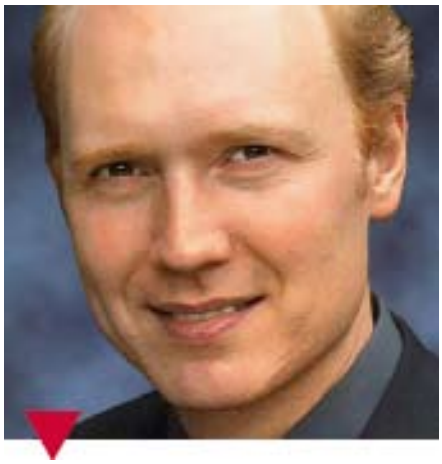
era may not require a ”frame grabber” card per se, but still requires an interface card. ”Traditional” frame grabbers, which are nothing else than interface cards dedicated to cameras, always provide valuable added functionality such as digital I/O lines that make them a cost effective solution. In the 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.

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 short 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 fueling 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 HSI etc. while transferring the original image to the host memory in real-time and with zero host CPU utilization.



Michael Noffz, Marketing Manager Silicon Software

The concept of frame grabbers has been evolved despite of declining market figures for this branch, Especially the analog frame grabber section suffers from a downturn, followed by a trend to interface-less cameras. At the same time there is a move to advanced tasks and solutions for frame grabbers. Besides an image acquisition more and more complex image processing tasks are swapped onto frame grabbers. Even new interfaces like FireWire and GigE benefit from product developments in this field. Application fields are divided in those with requirements of image acquisition and additionally of image processing. Applications, using line scan cameras or area scan cameras with high resolution or high speed requirements, still need a reliable and latency-free image acquisition in the future. Especially surface inspection in wood pro-

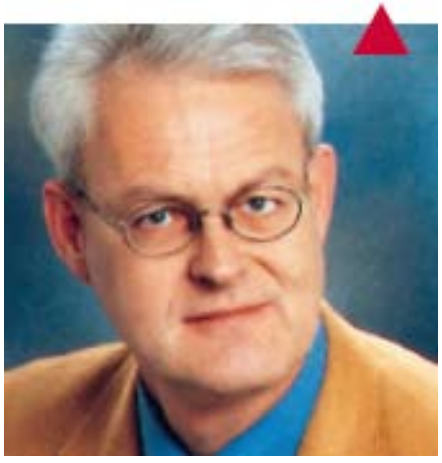
cessing and refinement industry and print inspection will have a future need of frame grabbers with high requirements to the production and processing speed.
Because of missing alternatives for real-time processing on frame grabbers, the field of applications is heterogeneous. Examples are scanner and sorting systems with need of documentation or inspection systems for glass and glass substratum with automatic detection of surface defects.

Helmuth Oberpaul, Managing Director Cosyco

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 just 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 inters face as well as SD-SDI/HD-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 or 1,024 x 1,024 pixels at 1,000 fps at 10 bits gray 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 Rieder, 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. Whereas in applications of the high-end level frame grabbers are used frequently. However, these frame grabbers must meet with 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 PoCL and PCIe compatible boards, and products with on-board processing units is very high. Applications with an extreme need of processing power in optical

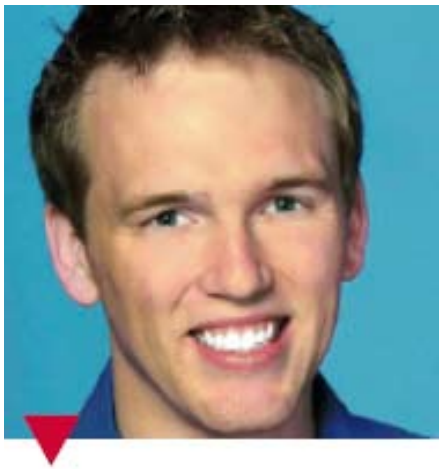


metrology or print inspection thus can be relieved from routine jobs like shading correction or Bayer Pattern interpolation.
New applications in the fields of traffic monitoring or surveillance demand for use of frame grabbers with numerous analogue inputs and the possibility to receive compressed and 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 pro-

cessing, 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.



Matthew Slaughter, Vision Product Marketing National Instruments

This is a tough question, as the line between a computer with a frame grabber and dedicated vision systems becomes more and more blurred. There are several applications that today require a PC with a frame grabber simply for the need for more processing power and flexibility. Current PCs can provide up to 3 GHz of processing power across multiple cores, and have as much memory as you care to spend money on. Depending on operating system choice, these systems also allow the flexibility to run more than just vision software, which is not the case in many smart cameras and vision systems. Many PC based industrial vision systems will handle other tasks such as motion control or data acquisition, tasks that a smart camera or dedicated vision system would have a hard time handling currently. It is also much easier to upgrade a PC based system than a smart camera based system, so any system that requires frequent updates would always benefit from a PC and frame grabber based system.

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