

A look back at the future

Industrial image processing developments and their impact on current components

This year, the VISION international trade show for image processing looks back upon 25 years of success. A quarter-century in which the image processing industry has steadily developed and changed like practically no other field. In the process, it has constantly penetrated new areas of application. Just as VISION accompanied this growth as the industry meeting place, the manufacturers pushed it forward in past years with innovative energy.

In Germany alone, the industrial image processing division of the German machinery and plant manufacturing association (VDMA) reported record industry sales of €1.5 billion for 2011. A success story that was not foreseeable at the emergence of the first technologies over 20 years ago. Due to further developments in micro-electronics and image sensing, current industrial cameras and even vision sensors achieve considerably higher performance and smaller designs alongside an increased range of functions. This development was primarily driven by the opening of new areas of application and the users' growing requirements for easier integration, high speed or better image quality. Requirements that have outgrown the varied technologies and components in recent years and shape the current industrial image processing scene.

The many facets of easy integration

Machine and equipment manufacturers are put under ever-growing pressure by shorter development times and maximum cost optimization. Individual components such as cameras or all-in-one systems like vision sensors should therefore be implementable with as much flexibility and savings in time and cost as possible, so more time is avail-



VisiLine®, a new GigE camera series introduced at the VISION, set standards in industrial image processing. The cameras, announced for the fourth quarter of 2012, combine numerous innovations that provide perfect image quality, easy integration and long-term reliability.

able for the specific application solution. The implementation of the GigE Vision® standard 6 years ago was an important stepping stone. The numerous advantages of the new interface contributed to rapid distribution in industrial environments. For the first time, cables up to 100 m in length could be used that on top of all this were significantly less expensive compared to conventional Camera Link® cables with their limit of 10 m. Furthermore, a simpler system design could be implemented, particularly in a multi-camera operation. Meanwhile, Gigabyte Ethernet cameras have become indispensable in industrial image processing and new models such as Baumer's VisiLine® excel with high performance and easy integration. The new models will be introduced at this year's VISION and are ready for GigE Vision® 2.0. Continued enhancement of this standard will bring along, even faster data transfer rates using

10 Gigabit Ethernet and image compression will further cut down data volumes. With implementation of the IEEE1588 Precision Time Protocol (PTP), network-wide, real-time synchronization of multiple cameras and associated network components moves into the foreground which will ease image evaluation in particular. Complex cabling effort in a fully PC-based vision application, especially in multiple camera operation, has been a decisive cost and time factor in implementation and maintenance since the beginning of industrial image processing. With BaumerLink, a solution was introduced as early as 1998. This high performance interface allowed both data and power to be transferred in parallel using a conventional, low-cost Ethernet cable for the first time. Ten years later, Baumer was one of the first camera manufacturers to offer a compact industrial camera according to the Power over Ethernet (PoE) standard.

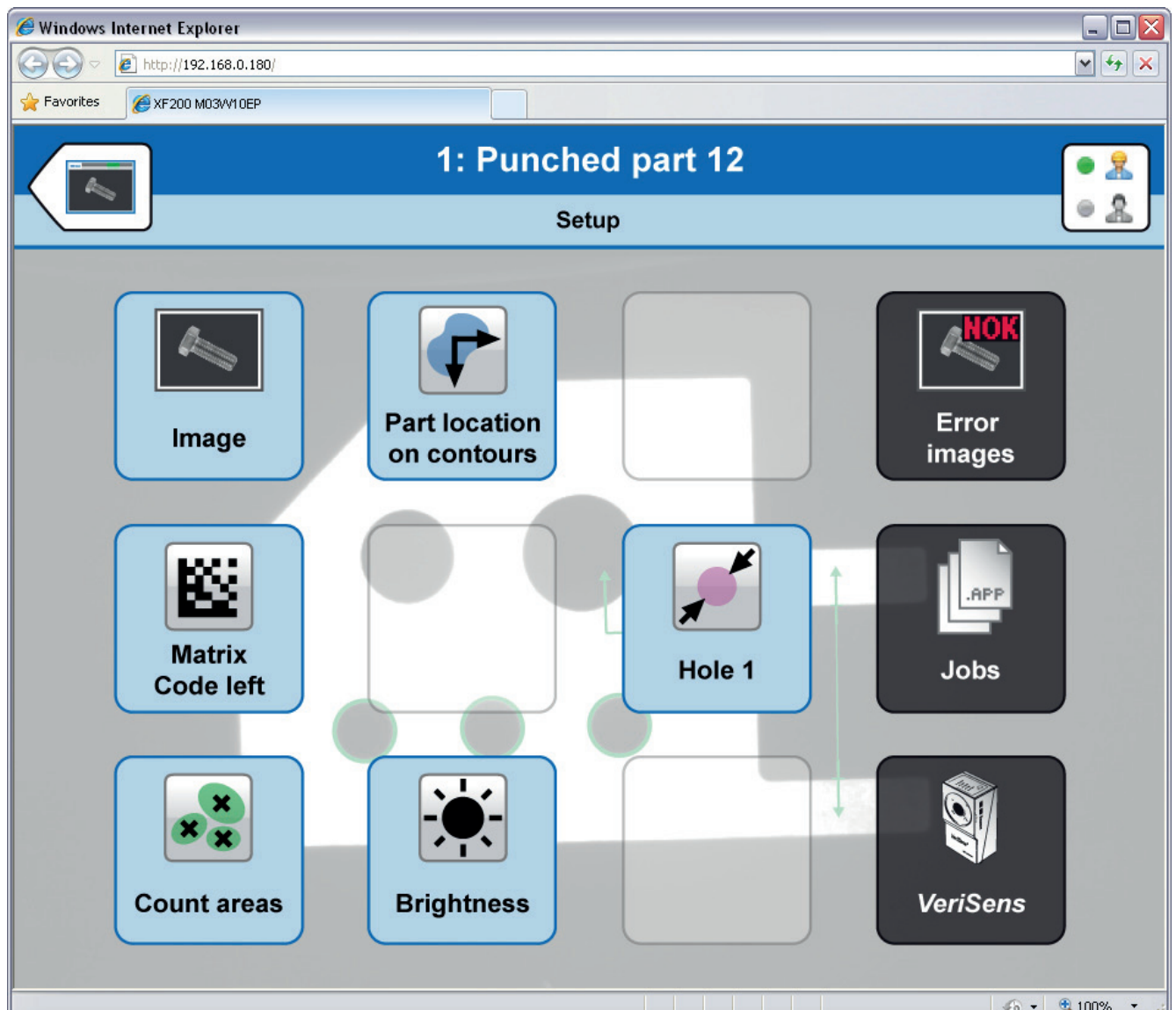
A single network cable allows data transfer and power supply at the same time, this way integration and maintenance of digital cameras became significantly easier and less expensive. Since then, PoE has been standard in all Baumer cameras and current series such as the MX board level models – adapted to the particular application requirements – also feature single cable operation. Easy integration and the overall vision system ready for operation in just a few minutes is something every machinery and equipment manufacturer dreams about. In 2006, the VeriSens® vision sensors closed the gap between classic optical sensors and PC-based vision systems. This complete image processing system in sensor format includes all hardware and software necessary for PC installation in less than 5 minutes. Building on this

concept, at this year's VISION Baumer is introducing the next generation of the VeriSens® web interface for ultra-easy configuration of the vision sensors. For the first time, the web interface can be set-up application-specifically in a customizable menu that allows the selected vision sensor settings to be changed with a keystroke later in the process. Commissioning and re-adjustment of an image processing system could hardly be easier.

When moments are decisive

To produce qualitatively flawless products, most manufacturers can no longer forgo image-supported inspections, particularly in quality control. The image acquisition or transfer speed has an influence on process speed. Ever faster production processes place extreme frame rate and bandwidth

demands on industrial cameras. Specifically developed for fast data transfer, the Camera Link® standard came into being 12 years ago. With data transfer rates up to 680 MB/s, the robust, high-performance interface is particularly suitable for high-speed applications. With 180 fps at 4 megapixel resolution, Baumer's HX high-speed cameras keep up with even the fastest applications. By using an image section (ROI), the refresh rate can be increased to over 100,000 fps. However, the large bandwidth of the Camera Link® interface entails comparatively high integration costs and less flexibility. With the SXG, Baumer introduced a dual GigE camera series in 2010 for integration of high-performance cameras with high frame rates into a cost-effective GigE network. The full performance of image



The new Baumer web interface allows for later configuration of VeriSens® Vision sensors a customizable menu called up in a standard web browser.



Thanks to the burst mode feature, Baumer HX series Dual GigE cameras are capable of rapid sequence image recording for later slow-down output. The 256 MB ring buffer allows intermediate storage of 60 images with a resolution of 4 megapixels at a recording rate of 180 fps.

sensors can be exploited by combining two standard Gigabyte Ethernet connections in a LAG (Link Aggregation Group). In addition, the redundant system concept enables increased transfer security by ensuring reliable operation even should one of the two Ethernet cables fail. The Baumer HXG camera models launched at last VISION represent the next evolution stage in rapid sequence image recording. Dual GigE cameras with flexible storage architecture allow for interim image saving. In so-called burst mode, a defined number of images is recorded for later "slow-down" output. In this way, the maximum frame rate of the CMOS sensors is fully exploited for fast process imaging. In addition, several different sections of an image can be transferred using the multi ROI function which goes together with speed increase and significant reduction of both data volume and system load.

Improved image quality will speed up evaluation

Perfect image quality not only facilitates reliable image evaluation but is also a prerequisite in the priority objective of zero defect production. The better the image quality, the faster and more accurately even the slightest assembly errors become evident and can be eliminated early on prior to incurring higher costs in the following production stages. Although for a long time CCD sensors were considered to have the best image quality, CMOS image sensors have caught up in the meantime. Originating with developments in the consumer goods industry, they have increasingly spread into industrial applications since the middle of the 1990s, because of their numerous advantages. Current generations of CMOS image sensors typically have equal

or even superior signal-to-noise ratios, higher dynamic range, greater sensitivity and speed. In addition, selected technical features contribute to the improvement of image quality. The CMOS models in the new *VisiLine*® series feature HDR capabilities (High Dynamic Range) to allow for images with excessive differences in brightness (e.g. from reflective surfaces). This results in consistent, high-quality images that ensure easier, robust and fast evaluation. Furthermore, HDR images eliminate the need for software-based merging of several images.

Technological development and industrial expansion

As a typical cross-sectional technology, industrial image processing has been able to penetrate very diverse industries in recent decades. With ever more modern production and manufacturing structures, the requirements for the industrial applications mass market will continue to be characterized by growing pressure on costs combined with a simultaneous increase in productivity and the objective of zero-defect production. The future development of technologies, individual components or complete systems will therefore concentrate primarily on ever-enhanced resolution and speed, greater sensitivity, easier integration capabilities and faster interfaces. These innovations also ensure a constant advance into new industries and non-industrial applications.



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