

Machine Vision Sensors, Systems Penetrate New Realms

Jim Montague, CONTROL ENGINEERING

Seeing usually means believing, but it less often means perceiving. Though this remains all too true for human eyes, their mechanical counterparts are becoming increasingly sophisticated, efficient, intelligent, network-enabled and, yes, affordable. These and other improvements are fueling the advance of machine vision solutions into settings where they were previously thought to be unusable or prohibitively expensive. This increases the wide variety of situations where machine vision devices can be used and sets the stage for future innovations.

To better understand the motivations, needs, expectations, and experiences of machine vision users, *Control Engineering* and Reed Research Group (Newton, MA) e-mailed a survey in January 2003 to a group of its readers. This survey was completed by 215 respondents, who indicated that they were involved in the evaluation, specification, recommendation, installation, and/or purchase of machine vision products for in-plant or OEM requirements. Areas evaluated by the survey included: in-plant vs. OEM requirements; applications; network usage; smart vision sensors; vision integrators; purchases in the past 12 months; future demand; obstacles to employing machine vision; and product selection criteria.

Responses to the survey revealed that, among those who specify, recommend, or buy machine vision products, 77% do so for in-plant requirements, while 39% do so for OEM needs. A slight majority (55%) does not consider machine vision products too costly or too complex to implement.

The survey also revealed that the average user bought six machine vision products in the past year, generating average spending of \$59,925 per user during that time. These data also suggest that machine vision purchases will increase during the next 12 months. (See "Purchases and Future Demand" pie charts.)

Diversity, networking, intelligence

While more than two thirds (69%) of the respondents use machine vision for inspection, they also use these sensors and systems in more than 17 other types of applications. The next most popular applications are for robotic equipment (33%); motion control (32%); and bar code reading (32%). [See "Primary Applications" sidebar in the online version of this article at www.controleng.com.]

When queried about networking, respondents reported that Ethernet TCP/IP and RS-232 are

presently the most widely used communication protocols for machine vision solutions. While 71% presently use Ethernet TCP/IP, 73% report that they plan to install more, or at least some, Ethernet on their machine vision systems in the next 12 months. Likewise, use of DeviceNet is expected to increase from 42% to 46% in 12 months, while use of Profibus-DP is expected to increase from 22% to 24% over the same time period. In addition, the survey revealed that 42% of respondents have used smart vision sensors, with 90% of this group reporting that these sensors fulfilled their requirements.

Also, 21% of those surveyed presently use system integrators to help with machine vision, while another 12% plan to use them in the coming year.

Affordability = opportunity

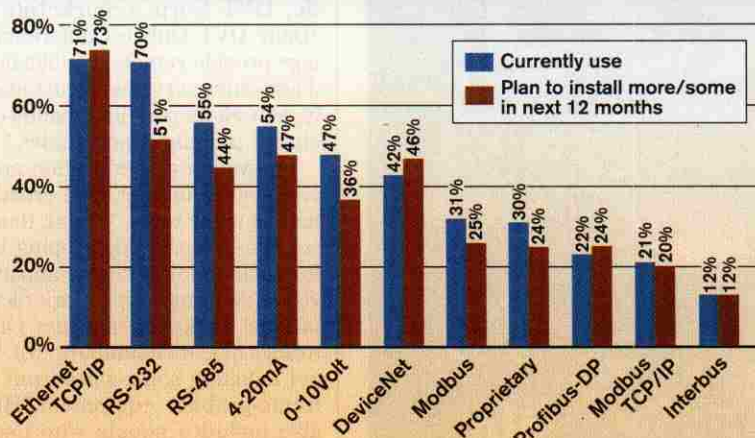
Because several economic and technological forces in machine vision are occurring simultaneously, observers can identify a variety of significant trends in this field.

What's new is that many users who had believed cameras and custom engineering in machine vision was too complex or costly for their applications are "suddenly opening up to putting in vision sensors," says Jeff Schmitz, corporate business manager—vision systems, Banner Engineering Corp. (Minneapolis, MN). "For example, we're

TRENDS IN MACHINE VISION

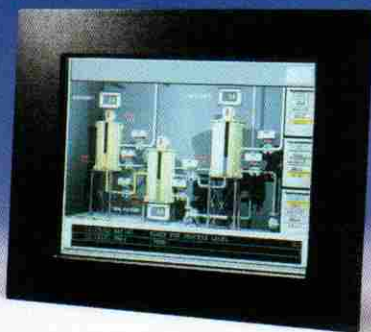
- More diverse applications using machine vision
- Increasing use of network protocols
- Smart sensors on the rise

Machine Vision Communication Protocols



Source: Control Engineering with data from Reed Research

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PRODUCT FOCUS: Machine Vision

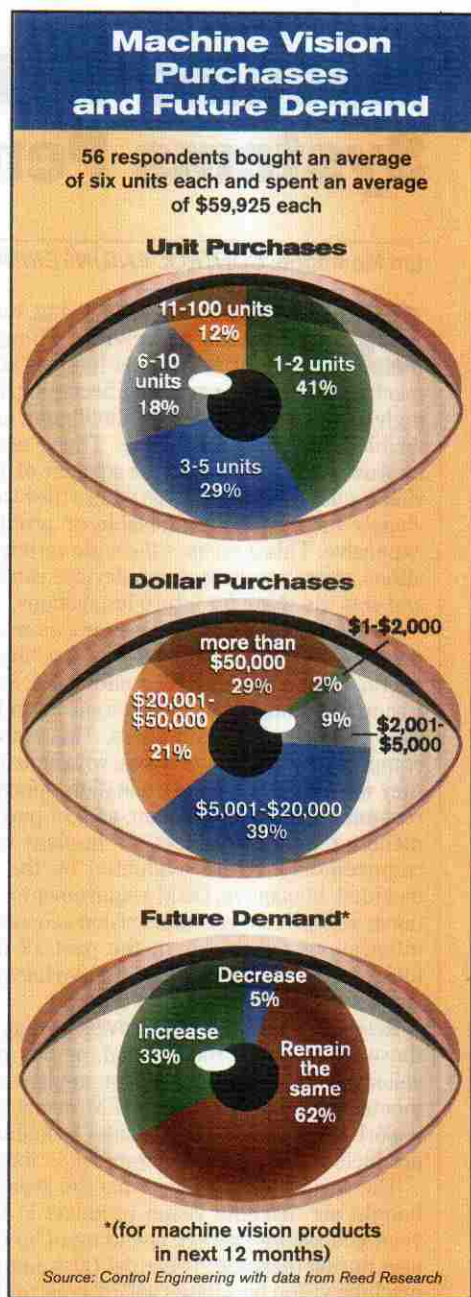
seeing significant growth on the plant floor in all the automotive sectors for tasks such as error proofing."

This is allowing automakers to use groups of previously isolated machine vision and laser sensors to implement complete system process control at each inspection station, rather than relying on periodic or batch inspections. Mr. Schmitz says other industries benefiting from machine vision's growing affordability and ease of use include medical and pharmaceuticals, packaging, food and beverage, and labeling. "Non-contact inspection with light has been done since the 1970s, but now these sensors are single nodes in a larger system that can send data elsewhere as needed," says Mr. Schmitz.

Not surprisingly, wider usage of machine vision solutions is fueling an increase in the types and capabilities of available vision equipment. George Blackwell, director of product marketing, Cognex Corp. (Natick, MA), says, "The In-Sight 4100 system with its remote head camera, for instance, is being sold into demanding food, beverage, and pharmaceutical applications because it's rugged and suitable for wash down, while the stand-alone 2000 and 3000 Series are popular with many users because they don't require a PC for configuration."

Besides offering increasingly varied functions for new applications, machine vision is also focusing on adding networking and communications capabilities. "The most significant trend we've seen in machine vision recently is the emerging use of Ethernet as a remote service and maintenance tool. Ability to monitor a vision system remotely and affect changes to parameters via a secure connection has greatly enhanced the system's value to the end-user," says Bob Settle, DVT Corp.'s marketing director. "Daily DVT Online Conferencing meetings provide remote troubleshooting and diagnostics services to customers globally, as well as real-time, hands-on, free-of-charge training opportunities."

Innovation and education are growing an existing market, and creating a new field in many ways. "I think there's a new, combined market developing in the U.S. for smaller, lower-cost, compact machine vision systems," says Mark Sippel, vision product marketing manager, Omron Electronics LLC (Schaumburg, IL). "This market is taking some sales from PC-based, frame-grabber equipment. However, it also includes people who used to stay away from \$12,000+ machine vision systems that were too complex anyway, but



are now willing to invest because many systems cost \$7,000 or less, and so the return on investment is much quicker." Machine vision is evolving like PLCs, to include use of Ethernet, distributed I/O devices, and intelligence, he suggests.

"Distributed intelligence means that machine vision devices will be able to inspect at each station of a manufacturing process, and help decide whether to reject or pull a substandard piece of work at that station, rather than waiting until it comes off the line. Increased networking means

improved data collection on individual inspections, as well as better quality monitoring and trend identification."

Machine vision products

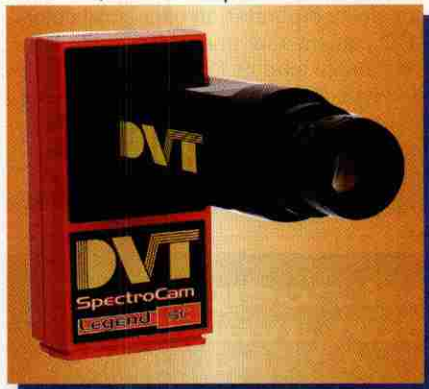
For more manufacturers of these products, visit *Control Engineering Buyer's Guide* at www.controleng.com/buyersguide.

For system integrators that can help with machine vision, visit *Control Engineering Automation Integration Guide* online at www.controleng.com/integrators.

To request free information about these products, visit www.controleng.com/freeinfo, and enter the following numbers.

Vision sensor merges color sensitivity, in-line vision

Norcross, GA—The SpectroCam color



machine vision sensor combines the color sensitivity of its built-in spectrophotometer, for enhanced color recognition and segmentation, with the capabilities of an in-line vision sensor. SpectroCam's Spectrograph splits incoming light into its constituent wavelengths along the x-axis and spatially along the y-axis, which allows it to learn the complete spectrum (380-900 nm) and detect small deviations. The peak location of the spectrum can also be monitored for LED quality control. www.dvtsensors.com

DVT

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3 new models offer faster vision sensing

Natick, MA—Three models of In-Sight vision sensors brings the family up to nine models in all. The company reports that its new In-Sight 4000 Series vision sensors are up to five times faster than previous models. Also, each sensor features dual processors, enabling simultaneous, dedicated vision processing and network communications. The series includes In-



Sight 4000, a high-performance vision sensor with fast frame rates and accelerated vision tool performance; In-Sight 4001, a high-resolution version for inspecting small objects or capturing images of larger parts; and In-Sight 4100, a compact, remote-head camera (1.25 x 1.25 in.) version. Cognex also recently announced that In-Sight sensors now have the ability to read and verify Reduced Space Symbology codes on pharmaceutical packages. www.cognex.com

Cognex

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Four-camera sensor has real-time performance

Schaumburg, IL—Omron Electronics LLC reports that its new F250 four-camera machine vision sensor, used in advanced, multi-angle applications, is the world's first vision sensor with real-time performance. Real-time rotation position compensation searches for parts or features located at random angles and positions, while maintaining high production speeds of up to 6,000 parts per minute. F250's Edge Code Technology enables precise positioning, even with poor image quality, while its defect inspection capability can detect fine scratches, dirt, and deformities for more precise detection. www.info.omron.com

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PRODUCT FOCUS: Machine Vision

Vision system-turned-sensor simplifies inspections

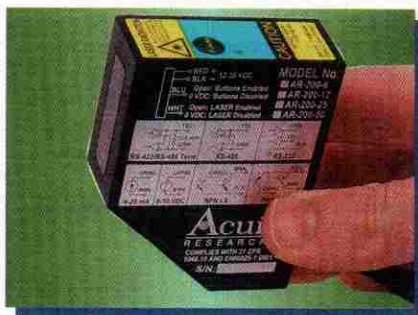


Minneapolis, MN—Similar to larger, more complex and expensive vision systems, PresencePlus Pro captures and analyzes images using one or more vision tools to generate judgement results. PresencePlus Pro is set up using a remote PC, but inspections are later stored in the system without needing the PC. PresencePlus Pro performs multiple inspections simultaneously, and inspects for translational and rotational variation. The system offers point-and-click automatic "Teach" or cus-

tom setup. www.bannerengineering.com
Banner Engineering **Enter 378**

Laser sensors combine accuracy, devices

Menlo Park, CA—Acuity Research's compact AccuRange 200 laser diode distance measuring sensors include AR200-6M, -12M, -25M and -50M models, which measure 6, 12, 25, and 50 mm ranges with respective accuracies of 12, 24, 50, and 100 microns. AccuRange 200 sensors also include serial digital and analog signal output connections for versatile



data acquisition. All AR200 sensors employ laser triangulation where reflected light from a target is viewed at an angle by a line scan camera inside the sensor case. The new displacement sensor has the sensitivity to measure distance to non-cooperative surfaces such as polished metals, glass, or water.
www.acuityresearch.com

Acuity Research

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Color CCD camera head is 5.4 x 6.0 mm

Secaucus, NJ—Panasonic Vision Systems' GP-CX261V color CCD camera

module incorporates an ultra-small color CCD camera and processing/controller. The camera module features a 0.25-in., FPC-type CCD that measures only 5.4 x 6.0 mm and is connected to a camera control unit (CCU) board that measures only 50 x 11 mm. The FPC connection length is approximately 85 mm. The small



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Five Myths about Low-cost, Pre-packaged Machine Vision Solutions

Myth 1: All pre-packaged, low-cost machine vision solutions are basically the same.

Because each category offers different levels of functionality, ease of use, and cost, users have to determine whether they need: simple, though less flexible, pixel sensors; task-specific vision appliances; or more sophisticated, flexible vision sensors and systems, which are also harder to set up.

Myth 2: Anyone can get any of these products up and running in minutes. While end-users generally can set up a pixel sensor or vision appliances without outside assistance, integrated vision sensors and systems nearly always require system integrator assistance, unless an end-user has extensive experience developing and using machine vision.

Myth 3: Expensive integrated solutions will still always be the best solution to every vision problem.

Absolutely not! The specific requirements of each application, as well as who will be using the machine vision system, should determine the solution.

Myth 4: All pre-packaged solutions are complete.

Some products are completely pre-packaged, but some pixel sensors and appliances (and most sensors and pre-packaged systems) offer a choice of camera/sensor, software packages, lighting, I/O modules, and networking options. Be aware that the list price for these products either will not include these extras, or it will reflect the lowest-cost configuration.

Myth 5: All pre-packaged systems have user-friendly interfaces. Manufacturers may say this, but it is the machine vision and computer experience of each user that determines the true user-friendliness of each system. Users must run through a demo to determine if it is user friendly.

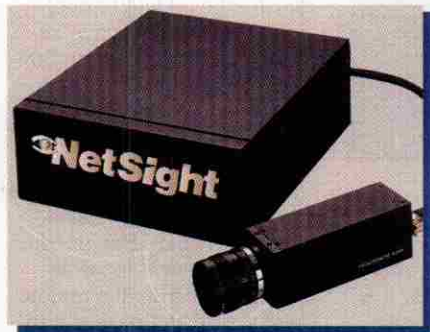
size and compact configuration can easily be incorporated into many devices, such as medical/dental imaging scopes or industrial inspection systems.

www.panasonic.com/vision/systems

Panasonic Vision Systems

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Processing engine joins with camera interface, tools



Billerica, MA—Pre-integrated NetSight systems from ipd, the intelligent products division of Coreco Imaging Inc., combine a processing engine with a camera interface, flexible software tools, and industrial communications in a small package. To shorten development time, NetSight ships

with ipd's Sherlock software environment. This graphical interface enables even non-programmers to develop vision applications. And, for integrators designing custom software interfaces, NetSight also provides a library of machine vision and pattern-matching tools. NetSight supports many camera models, ranging from VGA to megapixel resolution.

www.goipd.com

ipd

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Machine vision software has 35 tools

Marlboro, MA—Data Translation's machine vision software, DT Vision Foundry, includes more than 35 tools for image pre-processing, measurement, analysis, and data transfer. Users can also create their own customized tools. The vendor's application engineers can help users implement the solution that best meets their needs.

www.datx.com/machinevision

Data Translation

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