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'See' the Results

Vision and code readers feed data acquisition systems, analyzing more applications with greater consistency and easier setup than ever before. Here's how it's done.

Mark T. Hoske
Control Engineering

AT A GLANCE

- **Vision systems or code readers**
- **Wider applicability; less complexity**
- **Built-in lighting**
- **Industry-specific 2D requirements**
- **Feedback in integrated applications**

Seeing is believing, as the saying goes, so examine the following technology explanations and application tips to ease your next vision/bar-code implementation.

The basics

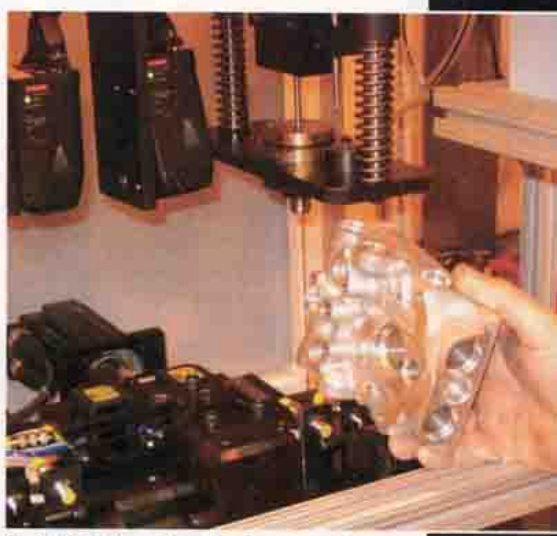
Bar codes in basic one-dimensional form are vertical lines of varied width and spacing (like those on packaged goods). More complex two-dimensional (2D) data matrix codes put more information in a 2D format. Bar codes are like one line in a paragraph; 2D codes are the whole paragraph.

Code-based information is used in product design and quality, inventory, lifecycle tracking, logistics. Information contained in the code can be extended into software for control and automation, manufacturing execution, maintenance, purchasing, customer support, resource planning, and warehouses. Because bar codes aren't just bars anymore, and more information is crammed into smaller spaces, the greater capabilities of machine vision systems and high-end reader technologies often help.

Conventional bar codes can be scanned effectively in many applications by commercial readers common in the auto-identification industry. OCR/OCV (optical character recognition/optical character verification) is still needed for legacy products in many applications; labels still need to contain human-readable info, as well.

With more complex 2D data matrix codes, in an industrial setting, a vision system should be used suggests Carl Gerst, Cognex ID program manager. Cognex is among vendors recently announcing ability to read Composite Symbology (CS) in addition to Reduced Space Symbology (RSS) codes on pharmaceutical packages for the purpose of product identification and traceability.

Recently proposed U.S. federal regulations will require bar codes on unit dose medications and increased reporting of safety problems involving medicines. Pharmaceutical companies will be putting information about drugs (along with date and lot) on a label in a machine-readable format, extending beyond manufacturing into the supply chain—hospitals and pharmacies through to prescription consumers.



Delphi Automotive Systems reads dot-peen data matrix codes on top of braking system part (above). Microscan Quadrus EZ smart camera (right) shows the 2D code on screen, without exterior lighting.

Semiconductor, circuit-board fabrication, consumer goods, and packaging are among other industries where 2D codes are gaining use, particularly for quality and lot tracking.

Automotive and aerospace industries are stamping or etching codes on individual parts for transmissions, power trains, and various subassemblies for better tracking of products

over their lifecycle. (Imagine the value of recalling 400 vehicles instead of 400,000.)

Machine vision is handy for reading more complex codes, especially those on metallic parts, because of shiny, matted, or rough surfaces, variability in dot size, lighting challenges, and necessity for reading at an angle at 600-2,000 parts per minute.

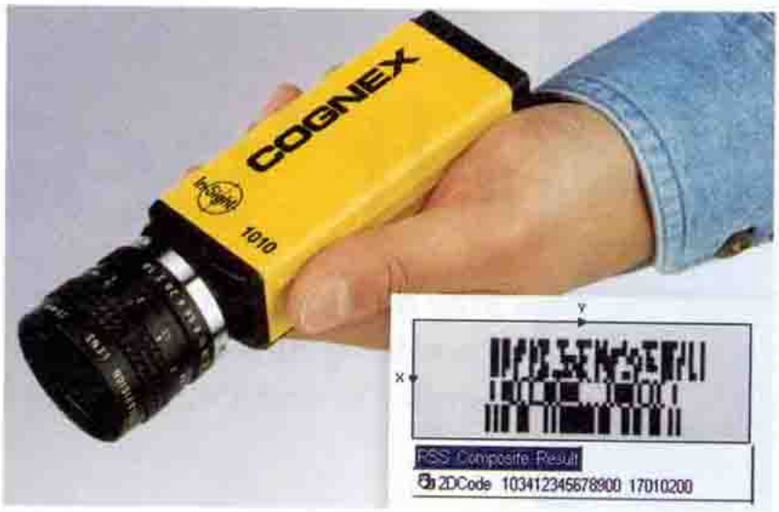
With high quantities of parts, Gerst explains, algorithms and optics perfected in machine vision can help read complex codes with a high degree of reliability.

"There's a big opportunity for the bar code to become the mechanism for adopting an information technology infrastructure to help identify problems in processes," Gerst says. Just by measuring and making a few related adjustments, increases of 50% in throughput or 10 more turns in inventory per year are readily achieved, he claims.

Delphi goes 2D

Automotive suppliers will be required to mark and track all parts and components, which helps track work-in-process and aids in managing warrantee repairs. Delphi Automotive Systems installed Microscan Quadrus EZ smart cameras on several lines to read dot peen data matrix systems on its parts for a new anti-lock braking system manufactured at a facility in Juarez, Mexico.

"Ability to identify and recall only those specific vehicles with the faulty part will greatly reduce the impact of a recall throughout the supply chain," says Craig Dring, systems integrator, Bar Codes Unlimited of Centerville, OH. Delphi Automotive decided to use dot peen marking for the data matrix symbol in this application for permanency through the part's lifecycle. Dring says "when it comes to



This Cognex InSite vision sensor reads Composite Symbology and Reduced Space Symbology codes.

Omron Electronics' V530-R180 Series two-dimensional code reader reads pin-stamped marks at any rotational angle and up to 60 degrees, for flexibility in placing the device on existing lines.

reading challenging 2D matrix codes, robust new smart cameras have the technological edge over some of the most sophisticated vision systems," avoiding the need for additional exterior lighting.

Dring contends that Quadrus EZ was the only "reader" technology he found "that could decode these challenging dot peen symbols, especially at these speeds," saving money compared to some vision systems. The device configures by aligning the locator pattern to the symbol and pressing the "EZ" button; software, lighting, and decoding algorithms are built in (as with some vision systems). The application also monitors deterioration in mark quality over time and triggers an alarm below a certain threshold, so an operator can inspect the marking system before it becomes a problem.

However, Mark Sippel, vision product marketing manager, Omron Electronics, says, "It's not so much the technology, but the education of the consumer. We hear people say, 'I didn't know vision could do that for under $10,000.'" Sippel described the "dark ages" of machine vision, a period when vision received a black eye for being complex and costly. Among Omron's offerings is the V530-R180 Series two-dimensional code reader, said to offer the steepest angle, 60 degrees, for reading pin-stamped 2D codes; see photo top right.

Cognex's Gerst adds that vision vendors also have experience interfacing with PLCs and a variety of I/O modules required for industrial applications. "And we know what to do with the data once collected."

Communications, data acquisition, and analysis are areas of experience for automation and control technologies and applications. For instance, National Instruments' Compact Vision System (CVS-1454), [July 2003 products, p. 45] designed for embedded use, allows users to acquire images with multiple cameras via three FireWire ports. Software such as Vision Builder for Automated Inspection or LabView can integrate bar-code inspection into machine vision. Considerations for communications vary depending on equipment capabilities, amount of data transferred, and user experience. For more on this topic, see Online Extras.

Options range from simple sensors to high-end systems; new applications are being engineered daily, some highly integrated with controls, well beyond conventional inspection or quality control.

Bar-code / machine vision check list

- ❑ Line scan
- ❑ Area scan
- ❑ Frame-grabber
- ❑ Color
- ❑ Monochrome
- ❑ Software speed
- ❑ 2D data matrix software
- ❑ Hardware/network connections
- ❑ Check goals, parameters, requirements

Source: Control Engineering with information from Data Translation.

Chesapeake Science, with PID

For example, PVI Systems Inc., a National Instruments Alliance solution provider, recently used vision technology as part of a closed-loop system to control tension in rope manufacturing. Doug Wilson, PVI Systems' (East Lyme, CT) president, chose a vision system to supply feedback rather than a complex array of individual sensors precisely aligned with the moving rope.

ElectroSolutions served as integrator for this wine-cap inspection project at Capalux-Pechiney.

The application at Chesapeake Science Corp. (Fiber Optic Sensor Systems), in Stonington, CT, measures the position of reference marks on strands passing through a 3 x 4-in. field of view. It checks to ensure that each element is the proper length. Information goes from a frame grabber to software-based PID algorithm that adjusts up to 14 brakes for tension/length control, for appropriate loading within the final product. Adjusting the tension enables the control system to line up the marks on all the strands. In addition, the system monitors three encoders and two tension sensors using data acquisition and counter/timer cards.

"We do a lot of vision and this seems a novel approach—the first time we used machine vision as feedback for PID loops. Usually vision's for inspection and gauging," Wilson explains. "In this application, machine vision is a lot more forgiving about position than what was originally suggested. We completed the project engineering within three days." A PC with LabView and Imaq vision software from National Instruments serves as the controller, the camera is STC400 from Sentech, and the Imaq-1407 frame grabber, PCI-6025E MIO and PCI-6601 counter/timer cards are from National Instruments.

Capalux caps

In a quality-control application, Pierre Alliaume, coordinator with ElectroSolutions, says a DVT SmartImage Legend 540 vision sensor inspects printing on the top and side of wine bottle caps and sees if the seal is properly set. Feedback on the Capalux-Pechiney line ejects rejected caps with a puff of air through the "pins" that carry them. Production rate of the Capalux site in St-Césaire (Québec, Canada) is about 600 caps per minute.

The photograph (above) is deceptive: "When it's running, it's a blur; the human eye cannot see individual caps," Alliame says. ElectroSolutions, Granby, Québec, served as system integrator.

Phone cards

Software to analyze images is as important as the connected hardware. Conversions Inc. of Glen Ellyn, IL, put together an application to inspect phone cards manufactured by Travel Tags at 850 pieces per minute, using the Matrox Imaging Library's OCV and bar-code modules with a model 1394 camera.

Dave Nay, project manager, says the application inspects printed bar codes and serial numbers, matching with data on the magnetic stripe for 100% inspection. It uses Lomax, one of 10 standard software products from Civision, a Conversions' division, to ease setup.

Choices

How should you choose a vendor or technology? Do you have staff expertise (tools are easier to use, with learning coming intuitively a half-day or less for some applications) or should you involve a system integrator with specific knowledge about higher-end technology or your specific application? Envision technical support, vendor partners, application experience, read rates, and life-cycle costs to "see" what's best for you in machine vision and bar-code reading. **ce**

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- A primer from Data Translation;
- Links to policy-setting groups;
- Lessons from Delphi on 2D codes;
- Links to items from Coreco, Redlake, others;
- Exclusive Magna Donnelly application.
- Protocol and software information from National Instruments; and
- Exclusive on machine-vision I/O capability from Witness Inspection Inc. and Wago.