A vision for quality

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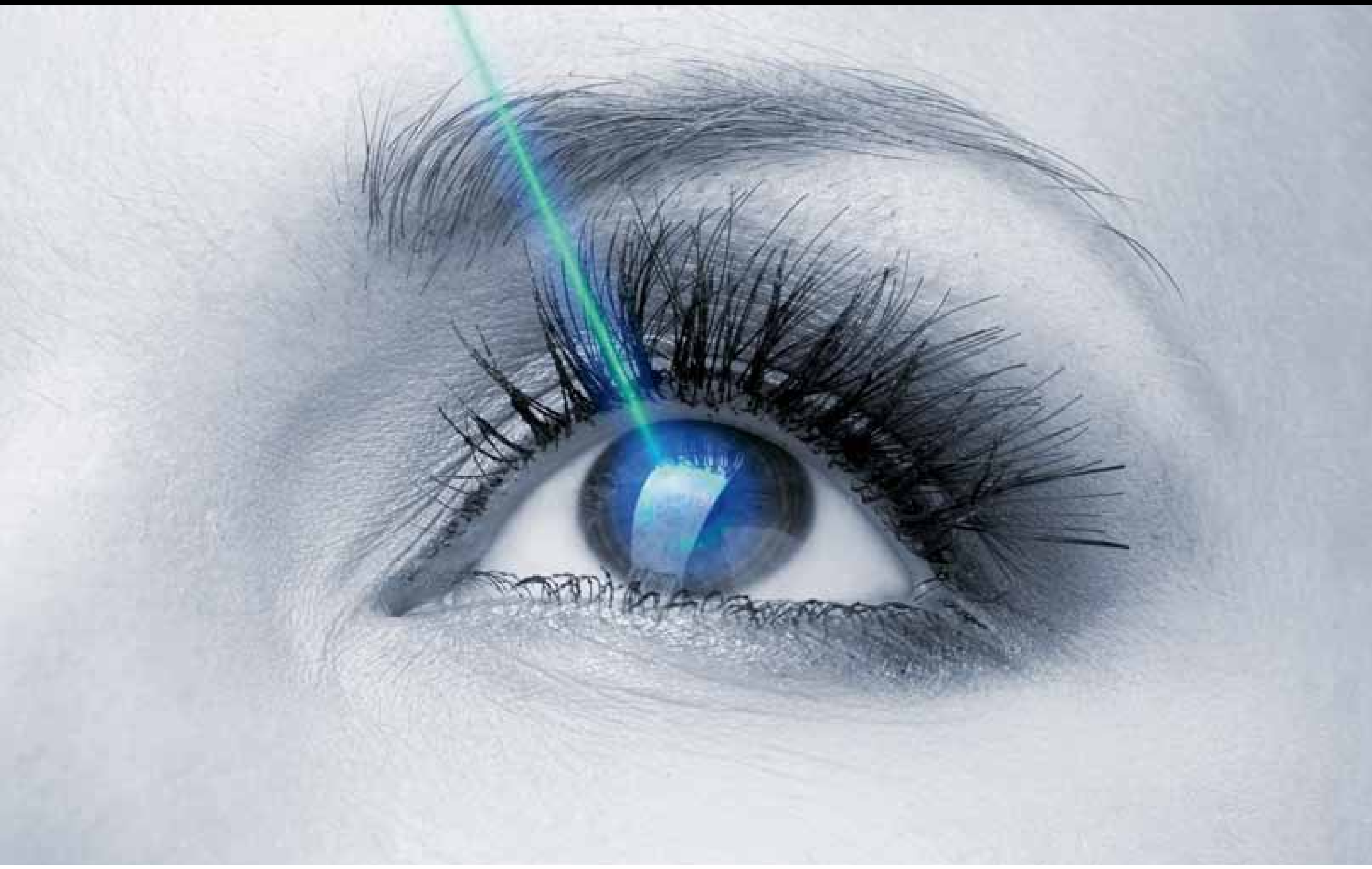

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If all food was identically sized, shaped and packed, life would be much easier for the food processor. One vision system could be customised exactly for all of your products — there would be no need to modify systems to accommodate different bottle sizes or different sheen on labels, etc.

But this isn't how the food and beverage industry functions. In fact, the rate of change in product presentation and the rate of release of new products has never been higher. So, if you are investing in a new machine vision system you need to ensure flexibility and ease of accommodating change within the system if you are to have any futureproofing.

Good vision systems can automate inspection processes and improve product quality, plant efficiency, safety and traceability.

This eBook will give you all the background you will need to spec out what you need from your vision system and highlight some of the advantages offered by new vision system technology.

Janette Woodhouse

Editor – *What's New in Food Technology and Manufacturing*

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Machine vision for the food and beverage industries

Glenn Johnson

Vision technologies give machines the gift of sight, replacing or complementing manual inspection tasks by using digital cameras and image processing. Vision technologies can be used across a range of applications in the food and beverage industries to automate inspection processes and improve product quality.

Machine vision can be defined as the automatic extraction of information from digital images. Such systems involve a number of technologies working together: a digital camera and lens, an illumination system synchronised with the camera and an image processing system to analyse the image from the camera. Systems can be built from separate components, but today there are many integrated vision sensor systems available, in which all the components are located in a single unit.

Integrated vision systems or sensors have obvious advantages in terms of reduced cost and complexity of implementation and come designed for common machine vision applications. Not all implementations are alike, however, and some types of visual inspection may present challenges that an integrated system cannot solve — for example, difficult-to-read surfaces that require customised lighting arrangements, or processing requirements that are more complex and require a separate image processing computer.

Whatever the solution chosen, machine vision systems can play a broad variety of roles in the food and beverage industry, providing numerous advantages in relation to efficiency, quality, safety and traceability.

Advantages for food and beverage producers include:

- Helping to automate quality control processes, collecting quality data at various points through the production and packaging process, and automating the rejection of defective or non-compliant product.
- Improving and optimising throughput, by providing the data that allows faster response to quality issues, before product is shipped, and allowing faster correction of issues.
- Ensuring product is packaged correctly and safely.
- Improving the speed, accuracy and efficiency of packaging operations.
- Cost savings in reducing waste and manual effort.
- Ensuring correct labelling throughout product packaging and end-of-line shipment packaging or palletising.
- Providing traceability data to help minimise the impact of recalls of products should they occur.
- Providing improved worker safety around automated systems while minimising impact on production throughput.

The four main functions of vision systems

The four main uses for vision systems can be described as measurement, counting, locating and decoding.

1. **Measurement:** Taking automated measurement of products or packaging to ensure they are within specification. A common example is in beverage bottling, where a vision system may be used to measure the level of liquid in the bottle to ensure it is correctly filled, and at the same time measure the position of the bottle cap to ensure it is applied and sealed correctly.
2. **Counting:** Detecting the number of items in the field of view of the camera. A common application is in packaging, to determine that the correct number of items is present.
3. **Locating:** Using pattern recognition to detect the presence of the correct item or its orientation. One advantage of using vision systems in this way is that they may be used to correctly orient a product or package before the next step in the process,

or to allow following systems to respond correctly, regardless of product orientation.

4. **Decoding:** Reading barcodes, stacked codes or 2D codes, as well as optical character recognition (OCR). Decoding capabilities are used to track products, sort them, validate data and labels, and to keep historical records.

Of course there are other existing technologies that can perform some of these functions, such as presence and distance sensors, as well as barcode readers. The main benefit of vision systems in these applications is that they are simpler to implement and can be used to perform multiple functions at a single detection point. For example, setting up a system of sensors to detect product orientation requires a complex configuration of multiple sensors and external processing, where a 3D vision sensor can detect the size and position of an object with a single operation in a single device. Similarly, a vision sensor can be used to check the fill level and the cap of a bottle, and at the same time read the label to ensure it is correct, and to provide traceability data — measuring multiple parameters and decoding at the same time.

Labelling and traceability

Food safety laws across the world, as well as high consumer expectations regarding food safety, now mean that food and beverage producers must invest in the best technology to ensure compliance and minimise the likelihood of a product recall — and the ensuing public image and brand damage problems. In the event of the need for a recall, effective traceability data can minimise the impact of the recall.

Companies that process, package, transport or hold food and beverage products must contain potential integrity problems before the product leaves the plant while at the same time providing detailed product history to their supply chain. Improved food safety and quality management through traceability will ultimately reduce the risks and costs associated with product contamination and poor product integrity.

Incorporating vision inspection systems ensures that information contained on the label matches the package contents, is legible and also checks for integrity.

Through their decoding capability, machine vision systems offer the following benefits in relation to traceability:

- Ensuring that product labelling matches the content of the package.
- Ensuring that product labels are legible and contain the correct required information, including ingredients, use-by or best-before dates and food allergy warnings.
- Ensuring barcode or 2D codes are correct on individual product items as well as ensuring the correct end-of-line labelling data that matches the content of the package.
- Recording data including batch and production date information for historical traceability records.

The chief advantage over barcode readers is that the entire label, including plain text data, can be read, compared and recorded.

Product packaging

As packaging line speeds increase and automation replaces manual inspection, maintaining product and packaging integrity and quality is critical. Food and beverage producers need assurance their food containers are free of contaminants before filling and properly sealed afterwards. For these applications, industrial machine vision plays an important role, mainly using their measuring, counting and locating capabilities:

- Measuring and locating: Ensuring packages are properly sealed, whether that be the caps on bottles or the plastic sealing on a food tray, for example.
- Locating and counting: Ensuring that all items are packed into a package (such as bottles in a six-pack).
- Locating, decoding and measuring: Ensuring that the correct label has been applied to the product, in the correct location and orientation.

End-of-line packaging

After individual packages have been made they are packaged in groups in larger containers or on pallets for shipping. End-of-line packaging systems include case erectors, case packers, case sealers, wrappers, palletisers and pallet wrappers. Additional case or pallet labelling is performed and industrial robots are often employed for filling boxes and building pallets.

Machine vision systems in this area of the plant are called on to effectively perform the same types of tasks as for the individual products — checking quantities, package sealing and labelling.

The increasing use of industrial robots to perform package filling and palletising presents another problem that machine vision technologies can solve. A vision sensor on the robot arm effectively allows the robot to 'see' what it is doing, in three dimensions, without complex arrangements of sensors. This allows the robot to pick up and manipulate objects presented in any orientation, place them in a box or on a pallet, and to know when the box or pallet is full — with only a single sensor.

Vision and sensor integration

There will be many instances where data from a vision sensor may need to be combined with outputs from other sensors (vision or otherwise) as part of the automation of the machine or system. Today, integration systems and software are available that simplify the integration of disparate sensors, making the customisation of an automation solution simpler and more cost-effective.

Multicamera and multisensor processors open up new possibilities for application solutions. Data from multiple sensors and cameras can be merged into a point cloud, evaluated, archived and transmitted, while sensors can be integrated via IO-Link for distance and height measuring purposes.

Such processor devices, along with supporting software libraries, make it possible to find solutions for sophisticated image processing tasks, including:

- Multisensor and multicamera based inspection, measurement and identification of objects and components in all areas of factory and logistic automation.
- Data recording and archiving, enabling quality control, traceability, process analysis and predictive maintenance for vertical integration in Industry 4.0.

Conclusion

Modern machine vision systems come in various forms to suit different applications, whether they be integrated visions sensors or made up of separate component parts. They are capable of performing multiple simultaneous detection tasks that previously would have required multiple technologies, and some are capable of measuring and recording in three dimensions.

The benefits of machine vision technologies for food and beverage companies are wide-ranging. Despite their higher individual unit cost, they offer opportunities to reduce operational costs through simplification of production sensing processes, reducing the number of sensing technologies required, and through their ability to perform multiple functions simultaneously and more effectively — improving efficiency, compliance safety and quality.

Why reliable, cost-effective ID and inspection solutions will reduce your costs

Mark Dingley

So what is it? It's consistent - it checks every product.

It takes action - if the product is not within tolerance, it either automatically stops the line or rejects the product. It's all about capturing quality data; for instance, it will show an analysis of rejected products, such as "40% were due to the front label not being placed straight", which is information a business can then use immediately to fix the problem.

Inspection technologies include vision inspection, metal detection, X-ray and checkweighing. This article focuses on vision.

What are the benefits?

Vision technology has many benefits over the human eye. As capable and flexible as it is, the eye just can't make fast, precise and repetitive measurements. But a vision inspection system can.

It gives manufacturers these key benefits:

- Automated quality control by establishing a reliable system that delivers over and over, and the ability to ensure quality based on specific parameters.
- Quality data is collected every time a product passes through for inspection; every product is monitored and the information sent into production-management systems for process control.
- Throughput is improved and optimised, by providing data that allows managers to react to upstream issues faster; the solution can also empower operators to fix issues to improve overall quality.
- It results in cost savings by reducing waste and manual efforts.

These systems also make it possible to demonstrate that reliable quality assurance processes are in place to reassure customers.

Vision systems make sure products are labelled and filled correctly, are compliant, in-spec and shelf-ready straight off the production line. These improvements in turn improve return on investment (ROI), as well as provide data for continuous improvement and enable lean manufacturing.Some people can be overwhelmed by automated inspection processes, but our [Matthews Australasia's] approach simplifies the process.

Firstly, what is the business's biggest quality issue? Then, which issues can automated inspection solve? After that, we look at what the critical issue is that the business has to have resolved, and what would be nice to resolve? From drilling down like that, we get the base solution that particular business needs.

Types of vision inspection technology

Three are three types of vision technology:

1. Vision sensors: this is the basic solution, giving a pass or fail. They have few tools and cover simple applications.
2. Smart cameras: these have faster cameras, offer more flexibility and can carry out more complex inspections.
3. Vision systems (also called machine vision systems): these PLC-based systems are fully customised and system dependent.

What type of 'quality' do you want?

There are two types of quality checks: control and assurance. Of course, it's completely up to each business which they use, but here is our view, from what we've seen in nearly 40 years of helping businesses improve their processes:

- Quality control (QC) is the traditional approach; it detects defective output.
- Quality assurance (QA) is the proactive 'lean' approach; it minimises the chance a business's output will be substandard and is all about process design.

In our view, the scale tips in favour of using QA as a guide to reducing waste, increasing efficiency and improving production methods overall. This is why reliable, cost-effective inspection solutions reduce a business's costs and improve competitiveness.

Matthews Intelligent Identification Pty Ltd
www.matthews.com.au

It’s what’s on the inside that counts

Inspection is key to improving your business’s production methods, reducing waste and increasing efficiency. Taking that one step further, reliable inspection is a must for any business that is serious about making the most of its resources and being competitive.

In recent years, the number of people suffering from food allergies has risen significantly. To ensure that every pack really does have on the inside what it states on the outside, 2D vision sensors from SICK’s Inspector product family visually inspect every product that leaves the belt at Crop’s. The frozen food manufacturer is therefore able to guarantee that consumers with particular food allergies will always have access to the right information.

The production sequences are subject to careful and comprehensive quality control, which includes the declaration of all ingredients on the relevant packaging. “This means that retailers are taking no risks whatsoever in purchasing our products. If a product was to be packaged incorrectly or not have all the ingredients listed on it, the entire batch is recalled without delay,” said Tino Blancke from Crop’s.

Integrated functions

“Each packaging line is equipped with two cameras,” Blancke explained. “One camera inspects the packaging as a whole and checks that the product sleeve has been applied correctly. The second zooms in closer and makes sure that the batch number and expiry date have been printed correctly.

“Each time the line has been changed over, an employee checks that the new packaging meets specifications. He then issues a command to the camera system that the packaging which follows must correspond to the recorded parameters. If there is any deviation, the camera transmits an error message and the line is stopped. The batch number is checked by counting pixels in the code window. If the result is too low, the product is ejected from the production line automatically.”

100 products per minute

Thanks to this practical approach, Crop’s has been able to reduce its error rate in terms of final packaging inspection to zero since introducing the Inspector 2D vision sensors. All starting products are delivered to Crop’s already frozen and there they go into interim cold storage at -21°C.

The production processes cover the mixing of ingredients and marinating, whereby the frozen goods chain is not interrupted. Multihead weighers then measure out the semifinished products. Next, they are filled into bags or trays, then fed to the packaging system and, finally, to the spiral freezer. From there, they are transported back into storage.

In order to ensure the cold chain is not interrupted, such a cycle only lasts 15–30 minutes. Quality control has thus to be performed within this narrow time window too. Therefore, up to 100 products pass the lens every minute and the products must be evaluated inside a fraction of a second. This is made possible thanks to the basic functions provided by the 2D vision sensor.

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SICK
Sensor Intelligence.

About SICK

SICK is one of the world's leading manufacturers of sensors, safety systems and automatic identification products for factory automation, logistics automation and process automation. As a technology and market leader, SICK provides sensors and application solutions that create the perfect basis for controlling processes securely and efficiently, protecting individuals from accidents, and preventing damage to the environment.

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