New System Integration

A new type of System Integration offering...

VISION SYSTEMS ISSUE

News on the latest automation projects designed, developed, manufactured and implemented, with full software development and integration.

Whether you are extending an existing production line, upgrading process equipment or building an entirely new plant, this is the essential read to ensure that your upgrade delivers on production, efficiency and reporting targets.

Vision systems, what's new

Machine vision has become an essential element of quality assurance and process control in manufacturing and its popularity is set to grow.

Advances in hardware, processing power and software algorithms over recent years have allowed companies to automate many tasks that would have been unfeasible only a decade ago. Getting such applications to work in a reliable and cost-effective manner requires considerable skill and experience on the part of the system integrator; frequently, decisions about the lighting, product presentation, camera fixturing and operation of a machine vision system can have as much of an impact on its performance as the choice of appropriate hardware and analysis technology. So where to start...?

Geoff Norwood
Optimal Industrial Automation

Product and process characteristics – all shapes and sizes

Significant variation in the size or shape of the products being inspected by the system can create problems for a single fixed camera position. Similarly, a variation in product colour or surface finish can create challenges for the selection of appropriate lighting. In response to these issues, automatic or manually adjustable camera fixtures can be used to ensure that all the relevant parts of products are in the image, and in focus, while lighting systems are available which automatically adapt to changes in product appearance in order to maintain image quality.

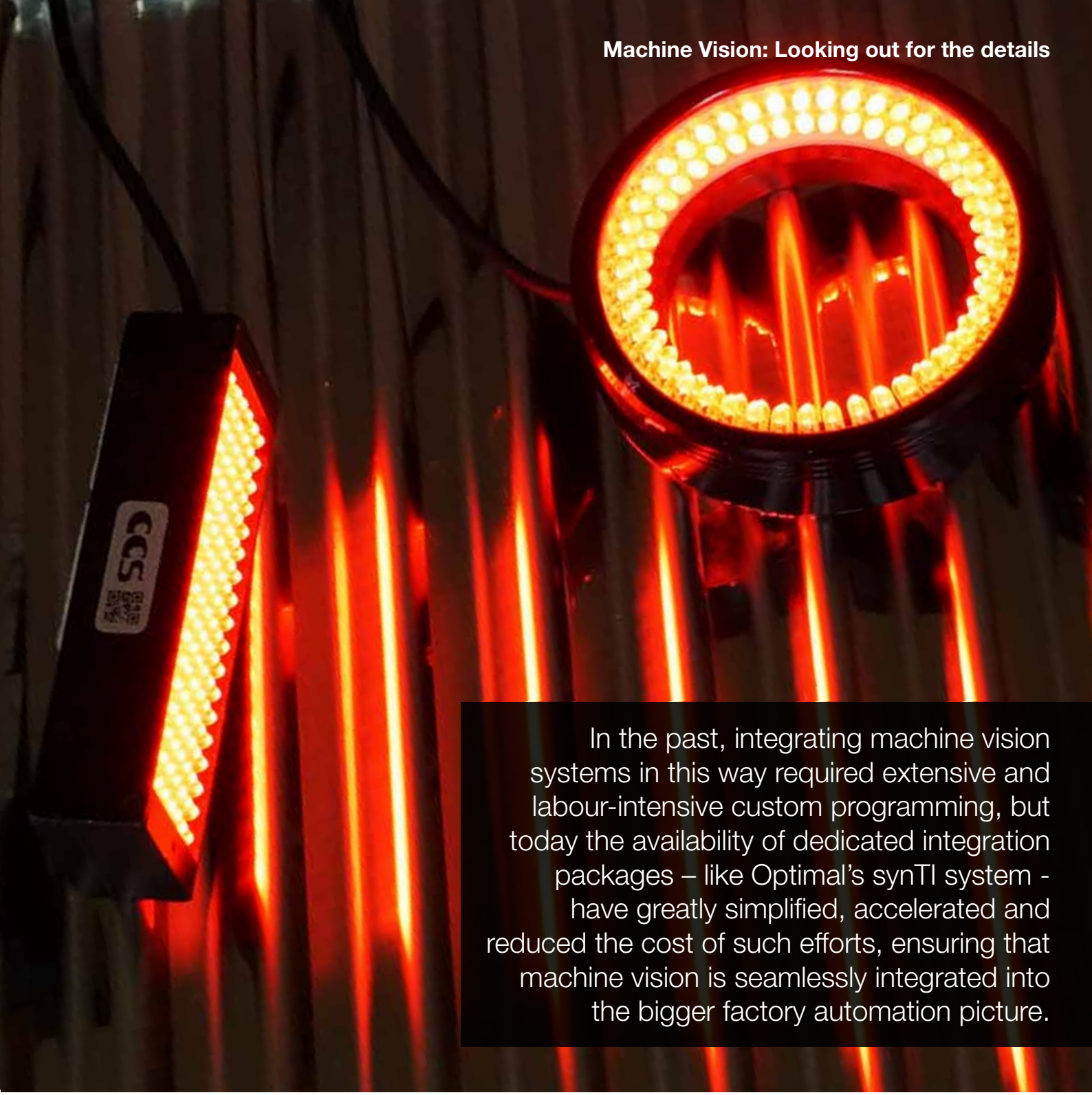
Sometimes there is significant natural variation in the appearance of good products. For example flexible packets, can vary significantly between one product and another. Advanced software approaches, including sophisticated calibration, pattern unwrapping and adaptive tools can be used to overcome these issues.

Appropriate product presentation and precise fixturing can also simplify image acquisition and processing. In general, time spent optimising the image before the processing stage will be repaid many times in the life of the project from a software development, inspection robustness, and system maintenance requirement point of view.

Image requirements – picture resolution

One of the key factors in determining the architecture of an automated vision system is the pixel resolution needed to achieve the required inspection functions. In industrial applications the tightest measured tolerance must typically represent 5 to 10 pixels of the acquired image. So a tolerance of +/- 0.5mm may require a pixel resolution of 100µm .

In addition, any feature to be detected must occupy a number of pixels: single pixel features are subject to noise and 'edge effects' and cannot be reliably detected. A good rule of thumb is that a feature should be 3x3 pixels for detection, so a resolution of around 150µm is required to detect features 0.5mm in size. Some special processing tools also have their own requirements. Optical character



In the past, integrating machine vision systems in this way required extensive and labour-intensive custom programming, but today the availability of dedicated integration packages – like Optimal's synTI system - have greatly simplified, accelerated and reduced the cost of such efforts, ensuring that machine vision is seamlessly integrated into the bigger factory automation picture.

recognition tools typically require individual characters to be 20 to 30 pixels high, for example, so a 12 point typeface would require a resolution of around 200µm.

Once the resolution is known, it is possible to define the camera and lens combination that will allow for this to be achieved over the object to be inspected. If this leads to very large image requirements, integrators can use multiple cameras, custom optics to select areas of interest, software to select areas of interest, or the use of linescan or contact image sensor (CIS) technology.

Speed – faster the better

If the product is moving continuously then the acquisition must 'freeze' the movement to avoid 'motion blur' in the image. This can be done through the use of very short exposure times, or with strobe lighting. In both cases intense light is required, and specialised sources are often needed to achieve an adequately bright image. Once the sensor has been exposed, the data must be transferred from the camera to the processor.

In general, high-resolution cameras have lower maximum frame rates, and this is also affected by the data transfer interface. 5 to 100 frames per second are typical in the field. Recently, a number of high-speed camera interfaces have become available, such as GigE.

The time required to analyse images after processing is highly dependent on image content and the algorithms in use. Higher speeds and more complex analyses are facilitated by increased processing power, and the most advanced systems make use of high powered intelligent cameras, and multiple, multi-core PCs with image processing distributed across them.

Finally, whatever the technologies involved, the machine vision system must work smoothly with the organisation's wider production and quality assurance processes.

Optimal offers latest vision solutions with Keyence

In addition to Cognex products, Optimal is now offering Keyence products to provide turnkey vision system solutions that will benefit customers in terms of both software and hardware performance. This new system capability expands Optimal's traditional portfolio of machine vision offerings to provide its clients with an even wider system choice.

With the increased use of machine vision within a wide range of industries this collaboration with a worldwide provider of machine vision systems will help many food , pharmaceutical, automotive and general process, printing and manufacturing companies looking to use this cutting edge technology to integrate new, powerful machine vision products into their existing production control systems.

In this wide range of manufacturing and processing industries, machine vision systems are more frequently being installed as part of an integrated quality assurance and traceability approach. Everything from reading the labels on tablet blister packets to selecting the potatoes you find on the supermarket shelf.

The technological advances in both the hardware and the associated software over the past decade have allowed companies to automate many packing, printing, sorting and quality assurance tasks, while greatly improving productivity and efficiency. The key to a successful system is using the best suited optical package with the correct data analysis technology and processing tools.

Optimal has developed its synTI® (synchronised Total Inspection) product specifically for the integration of disparate inspection systems and printing systems to ensure that the correct inspection job and associated inspection and printing equipment is used on the selected product. This can be expanded to encompass multiple camera systems for any desired inspection task and to produce reports for production control or process improvements. All of this can be integrated into an existing process management system on a production line.

Each machine vision application has its own unique challenges - the trick to a successful outcome is being able to develop the right package for the client. High speed production lines, variations in packaging and lighting requirements all have to be considered when selecting the hardware. This link with Keyence will provide a wider range of products to be used in the solutions being supplied by Optimal.

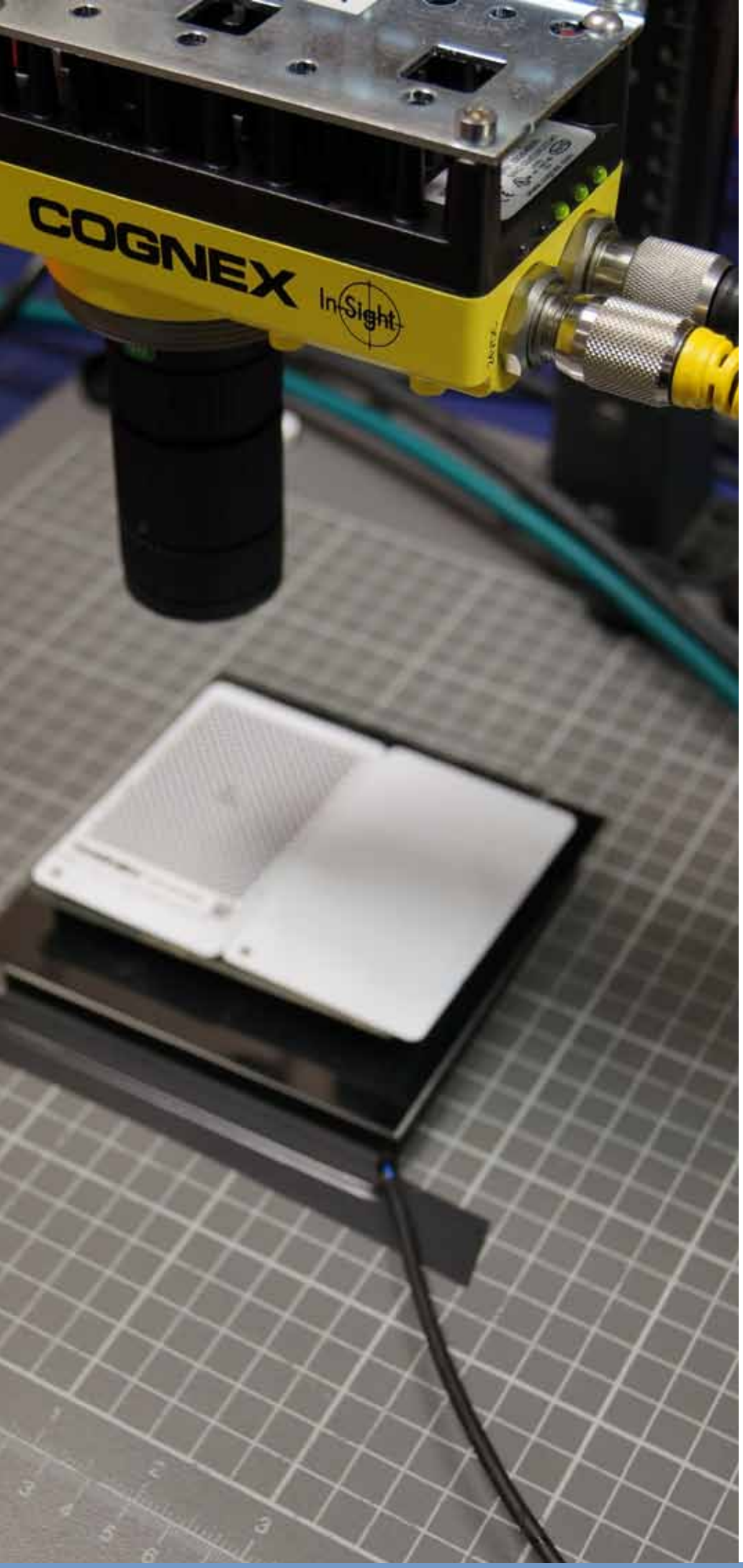
The Keyence vision range is of most significance to Optimal customers, it includes the company's IV (vision sensor), CV-X (smart camera) and XG (advanced vision) range of cameras, image sensors and image controllers offering both matrix (area) and line-scan application solutions.

The new CV-X100 for example offers an image sensor that possesses near-human judgement abilities by comparing with learned acceptable products for more flexible and stable inspection. The CV-X and XG Series offer advanced CCDs, high resolutions, simultaneous imaging and up to 20,000 parts per minute capture speeds.

The XG-7000 and XG-8000 packages meanwhile are part of the company's range of Ultra High-Speed, Multi-Camera, High-Performance Image Processing Systems. They combine robust fanless solid state hardware with super accurate vision and industry leading processing. Being integrated systems there is also less likelihood of compatibility glitches which can occur when using hardware and controllers from a range of different suppliers.

The full range encompasses application based offerings aimed from the vision beginner; with vision sensors and easy to use functionality, to the expert; requiring advanced high performance and custom functionality.

All products are supplied with as much or as little integration support as the customer requires from Optimal, this ranges from simple specification advice right though to complete turnkey system builds, commissioning and installation onsite.



Vision system inspects test strips

A five camera vision system has been deployed at a major pharmaceuticals company to inspect medical test strips.

The test strips are manufactured in high volume on sheets of a polyester-based material using a roll-to-roll screen printing process that builds up the components of the strips sequentially layer-by-layer.

High-speed inspection

Once the capability of a manually fed proof-of principle-system had been verified, the pharmaceuticals manufacturer commissioned the development of two high-speed machines to automatically feed the sheets of strips sequentially into the vision inspection system from a stack.

Although the machines used the same camera configuration, to match their speed, the image processing tasks were split between two PCs - one runs software to process the images of the three registration targets and the dot matrix code, while another processes the images of the reagent pads and the surrounding electrodes. In the high speed machines, the linear motors were controlled by a separate hardware PLC.

The PC processing the image data from the two outer cameras also runs Optimal Industrial Automation's own proprietary SynTI® software which collates the results from all the image analysis software tasks and performs a statistical analysis on the data which is displayed on an HMI. In doing so, it enables the plant operators to examine the specific nature of any misalignments that occur so the reel-to-reel manufacturing process can be fine tuned.

Managing big data vision systems

Optimal has developed a high speed, high data rate machine vision system for thin film inspection

Optimal has developed a bespoke machine vision system for the real-time 100 percent inspection of a thin film product used in the manufacture of electronic components. The new system builds on Optimal's 27 years of systems integration experience and makes use of the company's synTI® integrated Print and Inspect system software.

Optimal's customer for the new system wanted to replace its previous sample-based quality assurance regime with a more detailed 100 percent inspection approach, but it was concerned that its high manufacturing rates and detailed inspection requirements would make the required level of speed and accuracy difficult to achieve. The material travels at relatively high speed, and the inspection system needs to spot tiny defects in a web 900mm wide, as well as recording very accurate dimensional measurements.

Optimal tackled the problem with a system that uses three, synchronized high resolution, high speed contact image sensors (CIS) installed on the customer's production line between the manufacture of the film material and downstream slitting and packaging operations. One camera inspects the top of the web of material; the other two are focused on the underside.

The inspection system checks for defects in bands of dark and light coloured coatings on the film, and measures the precise width of the coloured bands. The inspection data is processed by the synTI® software and displayed in real time on the production line, so that operators can check the performance of their upstream processes and make any adjustments or interventions necessary to keep quality within the required tolerance limits.

A summary of the inspection information is also sent automatically to label printing equipment to be added to every batch of material prior to dispatch, and all data is stored in an online database to permit later management review.

With three high resolution sensors running at up to 10 frames per second, the system can generate and manage up to a Gigabyte of data every second, although the actual stored data is not

that high as the software is able to process the raw data into more a more manageable format.

"Thanks to advances in technology like high speed cameras, high speed communications and powerful processors, our synTI® system can now manage the process in real time.' says Geoff Norwood, Applications Engineer for vision systems at Optimal. 'The system means our customer can now inspect 100 percent of their product, 100 percent of the time."

The synTI® software used to run the film inspection system runs on four powerful PCs which are housed with the rest of the control hardware in a racked cabinet, also built-up and supplied by Optimal.

This combination of highly capable sensors, fast data transfer and powerful processing capabilities is allowing Optimal to solve an increasing number of challenging inspection problems for its customers "Modern cameras can do measurements, or use advanced tools like feature recognition or optical character recognition too," notes Norwood.

"In this case, we were using a small number of high resolution cameras, but in other examples we might use larger networks of simpler devices. synTI® will interface with a large number of measurement and output devices from cameras to check weigh scales, labellers or laser marking systems."

While Optimal is often asked to develop systems for continuous manufacturing applications like this example, its skills are also increasingly being used in high speed discrete manufacturing, where they have been applied to a range of tasks, including the detection of marks, stains and defects, non contact measurement and the identification of products by vision, character recognition or code reading tools.

"The ability to process high volumes of data in real time opens up a new world of possibilities in machine vision," concludes Geoff Norwood. "From 3D data acquisition to the use of image processing on ultra high speed production lines."

Integrating inspection

Optimal's synTI software provides the answer to rapid and secure production line configuration

synTI Machine Vision

synTI has been developed by Optimal to facilitate the integration and configuration of a wide range of production devices in a standard way, including regulated environments.

Packaging and printing lines may require configuration of Vision Systems, Printers, Labellers, CheckWeighers , and other devices with validated or approved settings for each product type.

synTI is a 21CFR pt 11 compliant system facilitating the rapid changeover of products, error free device setup, and generation of an audit trail of user actions on the line.

synTI is designed as a modular framework to manage production devices, products, batches and users. Integration with central factory systems is a key function, further automating the manufacturing setup process.

The addition of devices from various manufactures, or the integration with serialisation or other data from a custom source is therefore a question of an adapter being added onto the framework.

Lot codes, expiry date, serialisation data, barcodes and other batch information is sent to the line equipment at start of batch.

During production inspection results, images and measured data may be stored in a database and at the end of a batch reports may be generated, and delivered dynamically to a supervisory control or management system.

For non-regulated environments the benefits include centralised control of changeover, and historical records of production data.

Achieving serialisation...

Usually, (but not always), clients need to print batch/lot information, or serialised individual product codes on a product or carton together with a bar code or 2D code. They may then need to verify that the printed information is correct, read or write to an RFID tag and perhaps weigh the product.

synTI® is designed as the framework into which all of these different devices connect, and by either remotely selecting a pre-configured product and populating the dynamic data by downloading from a central system or by the operator selecting the product from an options list. Then synTI® can automatically configure all the equipment relevant to that specific product so that the line can simply be started.

After scanning or imaging the product synTI can collect and store all the information from the inspection devices in real time and log this data to its database. On batch completion the information can, if required, be printed to a report that is stored locally or delivered dynamically to a supervisory control or management system.

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