Vision plays increasing role in Sensing solutions

SIMON MARSDEN* CONSIDERS THE QUALITY ASSURANCE ROLE PLAYED BY VISION SENSORS.

Sensing systems on packaging machines themselves are generally the more advanced of those employed in the packaging process, often using much higher level equipment than, for example, that required for sensing on conveyor lines.

This could be the result of operating speed, difficulty in detecting the target, or physical constraints within the machine. In addition, as demands on production have increased, the time frame in which sensors must operate has been reduced.

So while sensing needs on conveyor lines may be relatively straightforward – for example detecting when an object has reached a particular point, signalling build-up of accumulated product, or counting – specialist sensing systems on packaging machinery often need to carry out more complex tasks. These include:

- Detecting printed marks on labels to ensure the motion control system accurately orientates and places the label on a bottle – carried out at high speed with typical positional accuracy of 0.5mm or less.
- Inspecting product dimensions to ensure they are within tolerance and rejecting those that fail to meet these tolerances.
- Sorting items by colour.
- Sensing in difficult environments, such as high temperature or in wash down areas where caustic cleaning liquids are used.

As a result, numerous specialist sensors are now available to meet and improve the accuracy, speed and reliability of detecting and inspecting products as they make their way through the various production processes.

Quality assurance is a prime application, particularly as marketing departments place increasing demands on production, such as: running shorter batches of different products, using special packaging for a particular customer, or labels positioned relative to some reference point on the package.

For these changing situations the line will be frequently re-configured, increasing the likelihood of errors being introduced.

Manual inspection is always open to inaccuracy, especially at high speeds, and the possible remedies of running the line at reduced speed or rotating the inspectors more frequently – to reduce the tiredness and monotony – may not necessarily be either acceptable or successful.

So when PC based vision systems came along they were quickly applied to quality assurance. Although costly – tens of thousands of pounds in some cases – they were seen as the solution to all inspection problems and, it was thought, would quickly pay for themselves by reducing labour costs and improving quality.

Proved unreliable

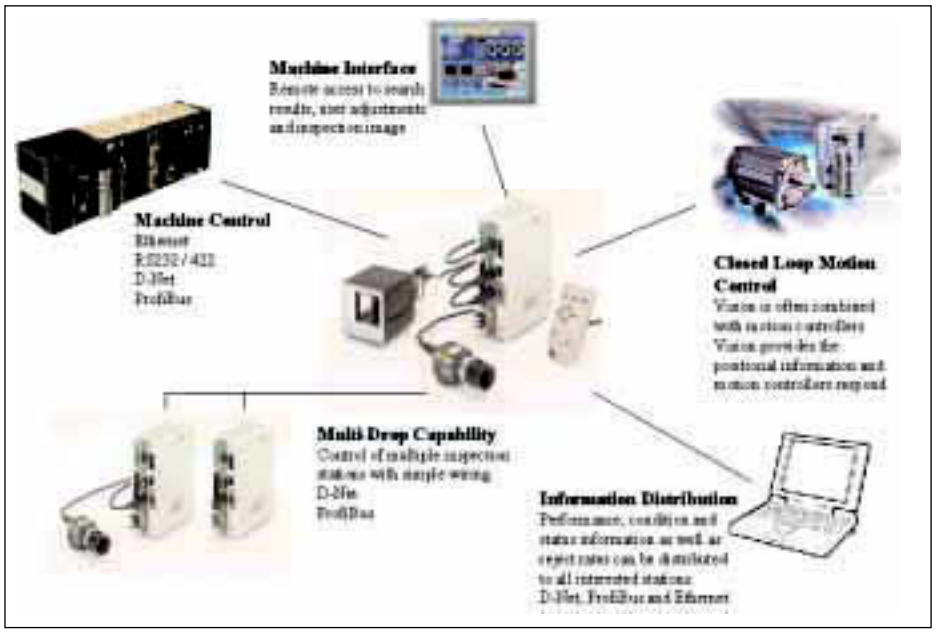
This was not necessarily so. In many instances they proved extremely unreliable and difficult to set up and adjust to evolving production line requirements, while support and modification required the services of an expensive software engineer.

However, the advent of more advanced and capable sensors, some offering measurement and tolerance checking facilities, increased the drive towards 100 per cent product inspection. Examples include colour sensors that generate analogue RGB (red-green-blue) outputs, to sort products by colour or shade.

Included in this specialist category are 'vision sensors'. These are distinguished from their more complicated PC based counterparts by being designed for ease of set-up and use, and by being significantly cheaper – from as little as a few hundred pounds.

Also, many inspection applications do not require the sophistication of a full PC based system, although vision sensors are nevertheless very capable devices able to carry out quite complex inspection routines.

Programming a vision sensor consists of configuring it with a hand held device, although PC software is readily available. Configuring the unit for the simplest inspections can be as straightforward as putting the camera into



Potential scope of a vision system: *The vision processor could operate in standalone mode - directly controlling its outputs to accept or reject the product accordingly. Alternative control system configurations could relay the status of the product back to a PLC for it to take control. (Illustration: Omron Electronics)*

'teach' mode, pressing a set button when good product is correctly in view of the camera, and then switching into run mode. The sensor will then monitor items that follow, and output an accept or reject signal accordingly.

More complicated inspections can involve setting the unit up to search within a defined area and then, on seeing the object within this area, perform a number of inspections. This is particularly useful when products are randomly orientated or positioned as they pass down the production line.

Other applications could involve pattern matching or recognition, where the sensor operates by counting the number of pixels present. During operation an inspection signal is issued to the sensor, which then compares the object with a pre-programmed threshold and outputs accordingly.

Most sensors have memory to hold multiple pre-programmed set-ups which can be automatically selected by an external input. Therefore, during the set-up routine for a new product a new inspection configuration can be automatically loaded into the vision sensor.

The potential scope of a vision system is shown in the diagram on the previous page. Here the vision processor could operate in standalone mode – directly controlling its outputs to accept or reject the product accordingly. Alternative control system configurations could relay the status of the product back to a PLC for this device to take over control.

Positional control

In other applications the vision system could be sending the co-ordinates of the product back to a motion control system for it to perform some form of positional control. This could be checking the orientation of a product and rotating it for the next process.

Integrating vision systems into existing machine and production line control system is easily achieved using an industry standard network, such as Ethernet, Profibus or DeviceNet. This will allow the control system to monitor and transfer data to and from vision systems, which is particularly useful on line changeover.

Additionally, advances in vision technology provide easier, more efficient programming of new inspection routines. For instance, suppliers such as Omron Electronics now have PLC operator displays that can accept video input signals, allowing the operator to monitor the raw camera image directly. In Omron's case the display also doubles up as a programming terminal, allowing the operator to set new threshold levels or program in new inspection routines, so removing the need to connect up a separate programming PC.

Many users of vision inspection systems discover they are also capable of providing additional important benefits, such as indicating trends in production processes and allowing remedial action to be taken immediately, greatly reducing downtime and virtually eliminating faulty production.

These secondary benefits provided by vision inspection systems mean that maintenance planning can be effectively carried out on an as-required basis, reducing costly over-maintenance. Also, by analysing the types of defects identified, production and maintenance staff can gain an insight into possible problem areas.

All of this means that expenditure on installing new or additional vision systems is becoming easier to justify. The table above compares the advantages compared with manual inspection. ■

Quality control: *A typical environment in which a vision system would be installed. Here it inspects characteristics of the bottle, which could include label placement, printed data on the label or checking that the closure is correctly fitted. (Picture: Omron Electronics)*

Manual inspection versus automatic

Manual quality inspection:

- Keeping production staff attentive requires regular rotation otherwise the repetitive nature of the task can lead to operator fatigue and therefore unreliability.
- Labour costs are high.
- Personnel are diverted away from more productive, value added activities on the production line or around the factory.
- Speed of modern production makes 100 per cent inspection difficult.
- Failures may be difficult to spot. Experienced staff may be required.

Automatic on-line vision inspection systems:

- Low operating costs once installed.
- Although past PC based vision systems were complex and expensive, this is not the case with the new generation of vision sensors.
- With a little training, production line technicians can quickly set up the equipment and make adjustments.
- Vision systems are now fast enough for modern production environments and make accurate 100 per cent inspection possible.
- Are extremely repeatable and reliable.
- Little user interaction required once up and running.
- Easily integrated with an existing control system.
- Can monitor the performance of the line to indicate trends and aid maintenance.

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