White Paper

Packagers Choose Machine Vision Quality Inspection to Reduce Waste and Boost ROI

By Mark Sippel, Vision Industry Specialist and
Mark Traxler, Staff Writer, Omron Electronics LLC

Abstract

Food and beverage packagers can choose from many solutions to help them achieve greater productivity and profits without investing in capital equipment to increase capacity. An increasingly popular solution is to reduce the acceptable waste threshold and boost return on investment (ROI) using machine vision to perform quality inspections. Recent technological improvements have made machine vision accessible to small- and medium-size packagers so they can achieve improved results and even pursue brand risk avoidance to maintain consumer and retailer confidence.

Introduction

Food & beverage companies invest heavily and consistently in solutions to optimize their manufacturing operations in order to avoid capital equipment investments to increase capacity. Slim profit margins compared to other industries, and increasing quality and variety demands from customers, retailers and regulatory agencies are typical reasons for taking this incremental improvement approach. Each investment gets scrutinized for its impact on ROI and only the strongest and most urgent projects get funded. Many packagers are lowering their waste thresholds in production and improving package quality using today's more focused, more affordable machine vision solutions. These can deliver a boost in ROI and help fund more capital-intensive production upgrades. A goodwill byproduct from improved quality is improved retailer and customer confidence.

ROI Drives Three Different Waste Reduction Scenarios

Packagers often believe there is no need to fix something that is not broken. For example, each manufacturer has a threshold point where the acceptable level of waste becomes a problem of waste. In every case, some sort of inspection—human or semi-automated—helps judge when waste turns into a problem. The inspection may take place in-line for work-in-process or at the final packing stage. Human inspectors provide reliable detection of multiple faults over a wide range of conditions. However, they can limit the number of inspections completed in a shift, effectively capping productivity at a low level. In many cases, machine vision systems dramatically increase the number of inspections; reduce human error, eyestrain or repetitive motion injuries; and allow an increase in production speed and accuracy. Here are the three most common waste prevention scenarios:

1. Use vision as a **diagnostic tool** to detect which problem(s) to repair on an expensive piece of machinery.
2. Use vision to **limit waste** in product, packaging and marking materials when fill level is too high or too low; when the label is crooked; or when an ink jet marking system produces blobs instead of characters.
3. Use vision to **remove non-saleable product** from the supply chain.

Even a slight downward readjustment of the waste threshold can generate sufficient savings to justify the cost of a vision inspection system and boost bottom line profitability.

Inspecting date/lot code and label quality

Gathering Data to Diagnose Machine Problems

Packaging problems are often symptoms that can be traced back to specific machine elements that need maintenance or replacement. The costs to repair a portion of the machine are a fraction of replacing the entire machine, and require less downtime. Unless the problems become chronic, most packaging machines continue performing for many years. Machine vision systems can provide real-time video to monitor operations via an HMI, or can record images stored as bitmaps that get time-stamped when uploaded to a data acquisition system. Using these video images as diagnostics can shorten troubleshooting time and reduce losses due to spoiled product.

Reducing Waste and Giveaway

Monitor bottle overfill and underfill

Package fill level tolerances, by law, are very narrow when it comes to permissible underfilling. However, business profitability demands that overfill be kept to a minimum, too. Machine vision systems can check fill level to verify minimum product requirements and alert when overfill results in excessive product giveaway.

In another case, a marking system may be using excessive amounts of ink, causing blobs instead of readable characters. On a high-speed packaging line, the seemingly tiny amount of over-inking can add up to hundreds of dollars a week in waste.

Removing Non-Saleable Product with Imperfect Labels

Vision sensor detects torn label

Products with torn, soiled or improperly positioned labels reflect poorly on the brand and bring into question the quality of the contents. The problem magnifies when those packages remain unsold on store shelves. If the label problem affects several cases or pallets, retailers may return them for credit or put the brand on probation. Such situations can negatively influence retailers' decision to promote new products or maintain shelf placement of existing products. Using a vision sensor placed after labeling/before cartoning prevents imperfectly labeled product from getting into the supply chain.

Machine Vision Goes Mainstream

More Affordable Vision Solutions

Machine vision hardware costs have come down in the past 5 years and improvements in the technology have lead to easier-to-install systems. This combination has allowed in-plant systems designers to add vision inspection to each stage in their process. In April 2003, *Control Engineering* magazine reported the results of their recent research into vision system usage and noted these trends:

- From 2003 through early 2004, respondents expected the demand for vision systems to increase (33%), while many thought it would stay the same (62%).
- The average of users surveyed showed six vision systems were bought for a total of $59,925.
- Among the many communication platforms, respondents expected Ethernet with TCP/IP (73%) and DeviceNet (46%) to increase in usage.

"There's a new, combined market developing in the U.S. for smaller, lower-cost, compact machine vision systems," says Mark Sippel, a vision industry specialist. "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."

Task-Oriented Solutions

Most machine vision products are applied to a single line or machine, performing some specific tasks. Until recently, vision system manufacturers have designed their products to be versatile enough to handle a wide range of tasks, thereby adding a significant level of complexity in programming, communication and resetting for production changeover. According to Sippel, "The trend now is moving toward task-oriented machine vision products that focus on the features required to deliver outstanding performance in just a single area."

A Brief Look Back

The first examples of task-oriented vision products came to market about five years ago with simplified vision sensors to handle pattern matching or simple pixel counting. These products combine a light source, camera, lens and processing into a single compact package that requires minimal setup. They revolutionized machine vision inspection with affordable products for common applications and with a substantially reduced engineering requirement to make them work.

The Next Generation

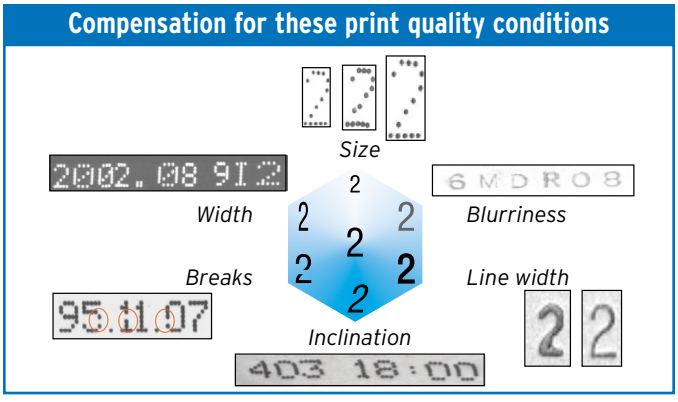
"Growing interest from key packaging industries—food and beverage, pharmaceutical, and health and beauty products—has demonstrated the need for higher-level vision system functionality but the same setup simplicity. One of the first of these new task-oriented vision sensors specializes in date code verification," said Sippel. These systems also offer the flexibility of greater choices in camera, lighting and lenses. The key difference is the reduction in inspection setup to a minimum of steps. "This date code inspection sensor can work more efficiently than a general-purpose vision system with date code verification capability. For example, Omron's F210 CF date code verifier bundles four important features for the task:

1. Built-in font libraries to eliminate character teaching
2. Advanced verification algorithms that accurately verifies date codes despite printing flaws
3. Automatic calendar update to reference date values after initial setup
4. Templates to reduce setup for frequently used code patterns like "manufactured on" date, "best before" date, and "expires on" date.

Vision Systems with Optical Character Verification

Packages today carry an important load of information relevant to customers and regulators: date/lot/factory codes and freshness/use-by dates. To make sure the right information is printed and the data is complete, many use machine vision systems to perform optical character verification (OCV) as well as optical character recognition (OCR).

OCV/OCR Technology Advances



Great improvements have been made in OCV/OCR in recent years that simplify setup and enhance inspection reliability. One major advance has been the creation of resident font libraries enabling the vision system to recognize characters in commonly used fonts. Before that, users had to teach the sensor to read one character at a time in the font used, making setup long and tedious. Omron made inspections more reliable by adding patented QUEST algorithms that detect defects in the characters as well as verifying them. Typical marking defects include missing dots or strokes from characters, inconsistent line width, inclination, size and blurriness. Products with these marking imperfections can be removed before getting into the retail supply chain.

More Effective Coordination

"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," said Sippel. "Increased networking means improved data collection on individual inspections, as well as better quality monitoring and trend identification." Popular networking options currently available in North America include Ethernet and DeviceNet. Vision sensors with Profibus communications are popular in Europe and parts of South America.

Marketing Realities and Consumer Confidence

"The package IS the brand." Today most packagers acknowledge this tenet of marketing success. In fact, customers treat every aspect of the product package as the brand. Key elements—label, freshness date, nutrition information, and tamper-evident safety elements—contribute to the brand impression at the

shelf-front buying decision point. Any fault in the package diminishes the consumer's perception of brand quality, often leaving it unsold. In times like these, consumer confidence and retailer commitment to brands are especially fragile due to economic stress and disturbing news of terrorism, product recalls and worries over food safety, consumer brand loyalty can waver. Packagers are now seeking ways to preserve consumer and retailer confidence in order to grow existing business and build a favorable reception for new products.

What's at Risk?

Food and beverage packagers historically put extensive resources toward establishing and maintaining brand value. Only recently has it become fashionable to make minimizing brand risk a priority. The authors of ARC Advisory Group's recently released study, *Food & Beverage Industry Plant-Level Expenditures Worldwide Outlook*, quantify the risk when failures in quality control create a problem. They point out that it "costs five times as much to recall a product as it does to distribute it.... Product recall costs can be enormous, particularly if a company exports products or is seeking new markets. Other costs, such as cleaning up the manufacturing unit or destroying certain batches and business interruptions, often lead to major profit losses." Adding in-line quality inspection such as machine vision systems can provide an early alert to problems or head them off entirely.

In summary, packagers can make a significant impact on their bottom line with the relatively small investment in today's more economical machine vision quality inspection solutions. The waste reduction benefits alone repay the costs quickly. The additional benefits in maintaining a high-quality brand perception while reducing risk of recalls or other regulatory action elevates the addition of machine vision quality inspection to an essential element for packagers' success.

Backgrounder

Omron Electronics LLC is a leading manufacturer and provider of industrial automation and electronic component products and solutions. Offering complete automation connectivity, extensive product groups include programmable controllers, sensors, operator interfaces, machine vision sensors, timers, counters, servo motors and drives, software, switches and relays. Omron also provides system integration services and offers data collection, inspection systems, motion systems and automation systems services and products. Omron Electronics LLC is the Americas subsidiary of Omron Corporation, a $4.5 billion global leading supplier of reliable, advanced electronics and control system components and services.

For more information about Omron's vision inspection solutions, visit our website at **www.packaging.omron.com** or phone **866-88-OMRON**.

OMRON ELECTRONICS LLC
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www.omron.com/oei

OMRON CANADA, INC.
Toronto, Ontario
www.omron.ca

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