Applying Machine Vision to Improve Safety, Product Quality and Productivity in the Food and Beverage Industry

Food and beverage manufacturers face increasing challenges in their efforts to deliver a safe and high quality product to consumers. Increasing production rates and higher levels of automation increase the challenges of assembly verification and packaging inspection. Mislabeled allergens can in the worst case lead to an injured customer and frequently result in expensive product recalls. Food and beverage manufacturers are also serving an increased number of niche markets and regional markets so they often have hundreds of different labels and need to ensure the correct label is affixed to every product in the correct position and orientation to avoid considerable expenses involved in remaking and reshipping the product. Increasing levels of complexity and automation are further increasing the challenges of diverting packages to the correct location within the processing plant.

Machine vision can help food and beverage manufacturers improve manufacturing quality and performance by eliminating defects, verifying assembly and tracking and capturing information at every stage of the production process. Vision systems can confirm that the product matches its label, that the label is in the right position and correctly oriented, that the safety ring is present, that the cap is correctly positioned and tightened on the label, etc. Machine vision can be used to track product quality such as ensuring that ingredients are uniformly dispersed, liquids in bottles are consistent in color, checking fill level, etc. Machine vision can also be used to divert products to the correct area of the plant for processing or shipping, divert flawed products off the production line before further value is added to them, and trace and track products throughout the manufacturing process and supply chain.

Avoid labeling mixups that can lead to expensive recalls

Kraft Foods Canada is taking increasing care to avoid labeling mix-ups that sometimes lead to expensive recalls and potential liability concerns. The barbeque sauce product line at the Saint-Laurent plant produces 30 different stock keeping units (SKU) at a rate of up to 265 bottles per minute. Ensuring that each individual package has the correct label is critical because some of the products have ingredients such as mustard and egg that certain customers may be allergic to. When the line is changed over to produce a different SKU number, the proper labels are manually loaded into the filling machine.


Figure 1: Inspection station on packaging line

However, the possibility exists that the person operating the machine might load the wrong labels or that a few wrong labels might be accidentally mixed in with the correct labels. To address this concern, Kraft originally used laser-based ID scanners to read the 1-D code on each label as it passed by on the line and send the results to the programmable logic controller (PLC) that runs the machine. The PLC compared the code to the proper value and if the code was wrong the package was ejected from the line.

The problem with the laser-based scanners is that they are only capable of reading codes located within a small field of view. The label design is market driven so codes may be positioned at any position depending on the designer's decision. As a result, when the labels are changed the code may be in a different position. This required that the position of the laser scanners be adjusted whenever the product line changed to a new SKU number, taking a considerable amount of the technical staff's time. Yet even when the laser scanners were positioned perfectly they still often failed to read the code.

"I suggested to Kraft that they consider image-based code reading technology," said Mike Palmieri, Senior Technical Sales Representative for Cadence Automation, machine vision integrator located in Ste-Thérèse, Québec. The basic idea behind image-based technology is that the reader captures an image and uses a series of algorithms to process the image to make it easier to read. A typical algorithm searches the entire image for the code and identifies the position and orientation of the code for easy

reading. Other algorithms handle degradations in code quality due to differences in material types and surfaces.

Figure 2: ID reader in operation

Dave Fortin, Technician for Kraft Foods Canada, started by replacing a laser scanner with a Cognex® DataMan® 300 ID reader in one of the barcode reading positions on the barbeque sauce line. From the moment it was installed, the image-based reader virtually eliminated read failures, providing 99.9%+ read rates. Kraft made the decision to replace the three other ID readers on the barbeque sauce line with ID readers. Four ID readers are required on the line because it has four spurs. Since then the company has also replaced the laser scanners on three additional lines with the DataMan 300. Read performance has continued to be outstanding with better than 99.9% accuracy. No adjustment is required so the technical staff has been freed from the need to adjust the position of the reader.

“ID readers have significantly improved the efficiency of packaging lines at Kraft Foods Canada,” Fortin concluded. “In the past our technical team had to spend a considerable amount of time adjusting ID readers on various packaging lines. The production staff also had to spend time dealing with the many bottles with good labels that the laser scanner ID readers were not able to read. The new image-based ID readers have solved these problems by providing near-perfect read rates. They are also economical to purchase and easy to maintain.”

Move to 360-degree inspection

Figure 3: Tabasco bottle entering the imaging hood for inspection

Tabasco® brand products have been made by McIlhenny Company on Avery Island, Louisiana, since 1868. McIlhenny Company has four different bottling lines that are used for bottles ranging in size from 2 ounces to 12 ounces. The lines operate at around 300 bottles per minute. The company is extremely quality-minded about everything from aging its product for up to three years to making sure every label is correct, straight, and in the right position on the bottle. Each bottle of Tabasco Sauce has a diamond label on the front, a rectangular label on its back, a wrap on its top neck, a cap, and a fitment underneath the cap to control flow out of the bottle.

“We use hundreds of different labels and it’s critical to ensure that the correct label is affixed to every bottle,” said Tom Grimsley, Jr., Bottling Manager, McIlhenny Company. “For example, if we produce an order intended for Germany with Austrian labels we will not only have an unhappy customer but also considerable expenses to remake and reship the product. Since we produce a premium product, we also want to be sure that every label is straight and in the correct position.”

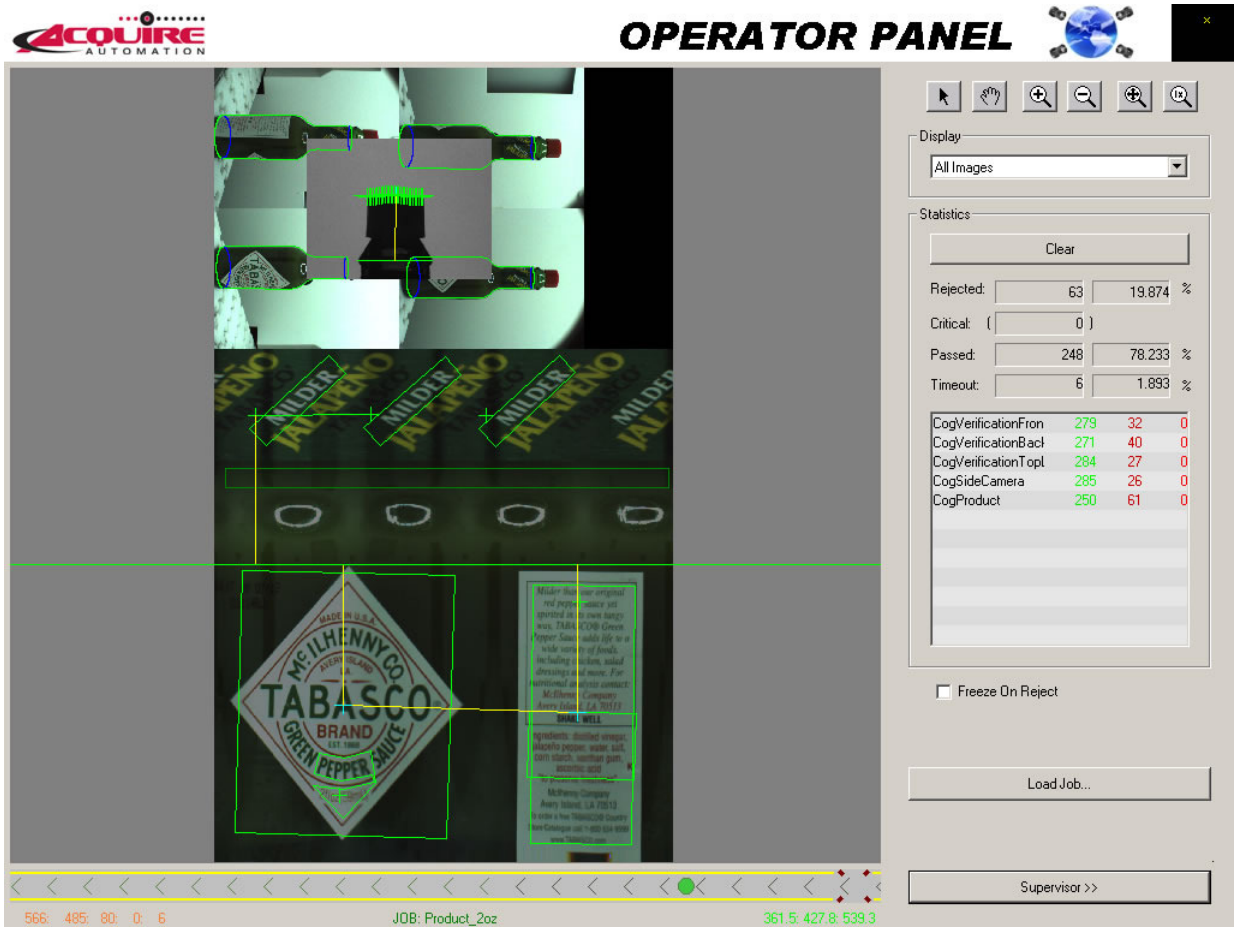

Figure 4: Run-time screen with a good image/acceptable product.

“In the past we used infrared light and photoeyes to inspect labels,” Grimsley said. “The previous method was capable of determining whether the label was in the correct position but could not determine if the label itself was correct. We are very quality-minded so we decided that we needed to find something better. About two years ago I went to a packaging trade show with our purchasing manager, night shift manager and maintenance manager to look at the latest vision inspection systems for bottling lines. We concluded that Acquire Automation had the best performing solution for 360-degree inspection. Their product uses Cognex OmniView® to produce a complete image of the circumference of the bottle. Their system offers an operator friendly human/machine interface and can easily be programmed for new labels and bottle sizes. We also liked the fact that their system measures 30 inches by 30 inches so it easily fits within the footprint vacated by our previous inspection system.”

Complete 360-degree inspection of unoriented bottles, tubes and cylindrical containers has traditionally required line scan vision technology combined with complex mechanical handling devices for image acquisition. Acquire Automation’s approach enables less intrusive integration options and higher throughput rates. Units can be in any orientation as they pass through the vision inspection system. The system selected by McIlhenny Company uses four cameras to obtain a 360-degree view of all features of the bottles. Cognex vision software technology uses images from multiple area-scan cameras positioned around the cylindrical object to instantly generate a virtual 3D surface model. It then creates a seamless, undistorted, unwrapped image of the complete surface to which optical character recognition (OCR),

barcode reading, and other machine vision software tools can be applied. “This inspection system provides confidence in the quality and conformance of every product we ship,” said Grimsley.

Grimsley said the inspection system has already paid for itself, primarily by ensuring that only conforming products are shipped to customers. He also said that the overall quality of the product has been improved. “If something goes wrong with the equipment that is causing skewed labels, we can identify the problem on the very first label,” Grimsley said. “Overall, we are more comfortable with our quality and feel confident that every product we ship conforms to our standards.”

Saving $250,000 per year with machine vision

A snack food manufacturer with multiple brands packages its individual serving products in boxes that are 3-feet wide by 2-feet by 1.5-feet tall. The boxes travel down a conveyor line to a diverter chute where they are sorted for shipping. Barcodes on the boxes, which are placed at varying locations and orientations, are read during a brief pause of the conveyor right before the diverter chute. The company chose its previous laser-based barcode scanner after seeing a demonstration, but found out after installation that the laser solution would not work because of perspective distortion and the relative size of code vs distance. The laser scanner was positioned 36” away and mounted at a height of 36” and aimed downward at an approximate 45 degree angle to the inspection surface. Because of the distortion caused by the mounting angle, as well as the distance from the barcode, the laser-based scanner was getting read rates of only 20 to 30%.

The company addressed the problem by stationing an operator at the diverter to manually direct boxes to the correct locations when their barcodes weren’t read. Because the manufacturer runs 3 shifts per day, the inefficiency of the laser-based scanner cost the company an estimated $100,000 per year for the three full-time positions. And because this approach sometimes resulted in boxes going to the wrong locations with the result that orders were occasionally filled incorrectly, resulting in returned products that could not be resold. Losses attributed to these mistakes were estimated at $150,000 annually.

Figure 5: UPC code used on snack package

Crescent Electric Supply Company, a machine vision distributor and integrator, came up with a better approach. “I knew the minute I looked at their setup that there was no way a laser-based scanner would work,” said Rick Rasbitsky, an application engineer at Crescent Electric. What he proposed instead was a different technology for capturing the barcodes, specifically the Cognex DataMan 500 image-based ID reader. Rasbitsky configured the ID reader with a 50 mm lens and mounted it exactly where the laser-based scanner had been. He also installed an external blue light (SV75) at a low angle to the box to better illuminate the 12-inch by 12-inch area of inspection and then connected the ID reader.

From the moment the image based ID reader started operating, it produced a 100% read rate. “The snack food company was surprised and also very pleased,” said Rasbitsky. “The device reads correctly 100% of the time, no matter where the labels are positioned or how they are oriented.” Since replacing the laser-based scanner with the ID reader, the food manufacturer has eliminated the cost of having one employee per shift manually divert boxes. It also avoids shipping products to the wrong locations, eliminating the losses previously caused by returned products. Management is so pleased with the ID reader, and the $250,000 annual savings it generates, that they are planning to purchase additional devices for other packaging lines.

Conclusion

Allergen management, product quality, assembly verification, packaging inspection and full traceability are critical issues facing the food and beverage industry. Machine vision technology can help food and beverage industry companies improve their manufacturing quality and performance by preventing defects, verifying assembly and tracking and capturing information at every stage of the production process. Smarter automation using vision systems and ID readers can help generate lower manufacturing costs and higher customer satisfaction.

For more information, contact Cognex, One Vision Drive, Natick, MA 01760-2059 USA. Tel (Toll Free): 1-877-COGNEX1 (1-877-264-6391), Fax: +1 508 650-3344, Email: pr@cognex.com, Web: http://www.cognex.com/