Regulations worldwide drive the need for OCR

In May 2012, the United States Food and Drug Administration (FDA) issued 24 mandatory food recalls for reasons ranging from salmonella to undeclared almonds. And it isn’t just happening in US markets. The International Standards Organization (ISO) includes tracking and labeling requirements for most agricultural products, while Japanese law includes documenting everything from agricultural chemicals to slaughterhouse operations (Abattoir Law).

In September 2011, the US government notified domestic and international food producers that food-tracking requirements would become more stringent in the future, and fines for non-compliance would become more severe. (See Food Safety Modernization Act sidebar.)

The US Bioterrorism Act requires that facilities have systems in place to provide product traceability so that any part of the food chain can trace back their source one step, and trace forward the food destination one step, on all food, within 24 hours. This requires a trail of information that follows each food item.

In the EU, the Rapid Alert System for Food and Feed (RASFF) warning system supports the traceability system by enabling the rapid exchange of information whenever a risk to food or feed safety is identified. If a member of the network becomes aware of a potential risk to human health, it notifies the European Commission, which immediately transmits this information to the other members—and beyond—so that corrective action can be rapidly taken.

In response, food producers and packagers are looking at how they can use track and trace technologies to document food production automatically and give their management team better insight at all levels of the supply chain in real time. Barcodes are a traditional solution to track and trace operations, but consumers cannot read barcodes. As a result, many producers are turning to optical character recognition (OCR) technology using vision systems that can read alphanumeric text, as well as 1-D barcodes and 2-D Data Matrix codes, to track food and beverages from raw materials to packaged product at high speeds and with greater accuracy than manual inspection or barcodes alone.

Food Safety Modernization Act: US Gets Serious About Food Safety

The US Food Safety Modernization Act includes 19 new provisions that will impact the food-processing industry. Several of these provisions are expected to increase demand for machine vision. Upon request, the FDA will gain expanded access to food production facility records. The agency may obtain records for tracking purposes or if there is reason to suspect a potential public health risk. In addition, the FDA, in coordination with the produce industry, will create a new method of effectively tracking and tracing fruits and vegetables to ensure that any contaminated produce is located and recalled in a safe and timely manner.

These new regulations apply to both domestic and foreign food producers selling goods in the US.
What is OCR Machine Vision?

While the specifics of each food recall in the US are varied, as were the producers’ costs and liability, one thing is certain—producers who do not have complete records of the products they make and ship will pay more to correct the situation than producers that do not. Simply put, you cannot manage what you do not know.

Machine vision systems equipped with OCR tools provide four key functions for food and beverage operations processing and packaging operations:

1. **Presence.** Check that product descriptions and tracking text have been printed on the product.
2. **Track and trace.** Track ingredients and packaged products throughout production.
3. **Identification.** Ensure the label matches the product, barcode and/or Data Matrix codes.
4. **Verification.** Verify that the correct characters are printed clearly for customer safety and brand management.

Vision systems accomplish these tasks by acquiring pictures of the product on the production line. Vision systems easily handle the high speeds found in food and beverage manufacturing and packaging lines. The images are then analyzed using the OCR tools on the vision system that locates the text string and “reads” the alphanumeric codes. These codes can include batch, lot and date codes, as well as data for print and label verification. Vision systems acquire and process these codes in fractions of a second, then pass the extracted data to the factory network for the user to analyze and store data, improving supply chain management and limiting liability in the event of a recall. Simultaneously, the vision system can be programmed to do additional inspections; from ensuring safety seals are present to reading barcodes or 2-D Data Matrix codes. Vision systems can be configured to do one or multiple tasks, depending on the requirement of the manufacturer.

Benefits of OCR technology for the food & beverage industries

OCR technology can benefit food & beverage manufacturers by:

- **Accelerated response times** – If there were issues in the supply chain, OCR gives manufacturers the information required to hone in rapidly and take corrective action.
- **Reduced liability** – Incorrectly marked packages that include allergens or contaminated food and beverages can result in legal action and public health hazards. OCR documentation can help identify the source of the problem back to the supplier.
- **Improved productivity** – Automated OCR increases process efficiency by eliminating human intervention in more areas while improving accuracy and reliability.
- **Simplified production** – OCR codes are also human readable, augmenting the 1-D barcodes and 2-D Data Matrix codes markings.
- **Increased customer satisfaction and ensured compliance** – New regulations in developed markets require, or soon will require, 100% inspection, tracking, and tracing of food and beverages similar to the requirements of pharmaceutical products.

Tracking each step in your process

OCR machine vision technology is a proven, mature way to track food and beverage processing from the raw material stage to packaged product. Some of the more common applications for OCR systems include:

- Ingredient/raw material receiving
- Real-time production tracking
- Date code accuracy and legibility
- Lot code and batch verification
- Expiration date verification
- Label verification
- Mold cavity print quality inspection and verification (e.g., bottles and containers)
- Label placement, quality, and brand management
- Automated warehouse, picking, and shipping data management
- Expedited product returns and customer credits
Six questions to ask when choosing OCR technology in a vision system

With suitable lighting, the proper image acquisition device configuration and seamless connectivity to a factory network, food and beverage manufacturers can use the OCR tools in a vision system to make immediate improvements in productivity, product documentation, and supply chain management. In addition, when looking for a vision system to accomplish these goals it is important to consider these critical points when evaluating OCR software:

- Can the OCR software read any printed font?
- Can it read text when there is little contrast between the text and background (colored text or background noise)?
- Can it read text in spite of changing lighting conditions that affect contrast?
- Can it read text with a lot of letter-to-letter variation, skewed letters, or touching letters?
- Can it read text strings that are poorly printed, scratched, or with washed-out characters?
- Can it read text regardless of surface type, including glass, metal, cardboard, ceramic, and plastic?

Features to look for in an OCR tool

Pre-processing and image correction
Many OCR software tools will not include image correction and filtering as part of their toolset, requiring the user to use a separate tool for this step. This additional step will likely slow down the system’s inspection speed and slow down the production line. The best machine vision systems feature pre-processing and image correction in their OCR tool to improve contrast, correct for changing lighting conditions and filter out background noise in the image. Including pre-processing and image correction makes it easier to train the software on a new font, program the system for different production lines and operate the system as light conditions change throughout the day.

Segmentation
To a machine, a picture of written text is nothing more than a collection of dots ranging from white to black and thousands of grays in between. OCR tools recognize that these dots form lines or strokes and that groups of strokes together form letters. Tools such as OCRMax® from Cognex use special segmentation rules that allow customers to train the system on virtually any printed font with the exception of scripts (cursive writing). OCRMax can even accommodate letters that touch using advanced segmentation in conjunction with its classification and fielding functions.
The Future of OCR-enabled vision systems in the food & beverage industry

As government regulations and the public’s demand for safer products increase, more food and beverage manufacturers will need to deploy machine vision systems with OCR functionality to address these challenges. OCR technology will need to be robust enough to solve applications in tough environments more consistently and reliably. It will also need to be scalable and dynamic enough to adapt to changes in the production process. Ensuring the OCR functionality in your machine vision system is up to the task will put you on the path to regulatory compliance, limit liability and improve efficiencies all along the supply chain—from accepting raw product to quality-checking the final package and expediting customer returns.

Classification and fielding

Advanced OCR tools use segmentation as well as classification and fielding to improve read accuracy. Classification refers to comparing different mathematical analysis of a specific letter to determine whether the letter is more likely to be the letter “B” or the number “8,” for example. OCRMax gives the user the ability to use two different approaches to classifying each letter to deliver one of the highest OCR accuracy scores on the market. Fielding functionality also helps improve read accuracy. Going back to the “B” versus “8” example, if a given text string holds a date code, programmer user can specify to the tool that only letters will be numbers at a specific location. This gives OCRMax one more way to be sure that an “8” is a number, and not a “B.”

A cautionary example

In May and June 2011, a novel strain of Escherichia coli O104:H4 bacteria caused a serious outbreak of food-borne illness focused in northern Germany. The outbreak resulted in 50 deaths, US$2.84 billion in human productivity losses and US$306.2 million in compensation payments to affected farmers throughout Europe. In the end, this catastrophic incident has underscored the importance of accurate product identification and traceability in the food supply chain.

The ripple effect of this outbreak will be with us for a long time. Many consumers still mistrust fresh food. According to a Neilsen survey, three quarters of Germans polled are demanding the producers and processors of food take more responsibility for its safety. This responsibility begins providing adequate consumer information on the packaging of fruits and vegetables, which is lacking even in the developed world. A recent analysis of the packaging of 2,100 products revealed that less than one percent of the fruits and vegetables offered at supermarkets feature details that would allow the food to be traced through the supply chain. Implementing reliable, automated optical character recognition functionality would provide major benefits for the food and beverage industries.