

COGNEX DEEP LEARNING

Easy-to-Deploy Deep Learning-based Solutions for the Packaging Industry

THE GLOBAL LEADER

IN MACHINE VISION AND INDUSTRIAL BARCODE READING

Cognex®, the leading supplier of machine vision and industrial barcode reading solutions.

With over 3.5 million systems installed in facilities around the world and over 41 years of experience, Cognex is focused on industrial machine vision and image-based barcode reading technology. Deployed by the world's top manufacturers, suppliers, and machine builders, Cognex products ensure that manufactured items meet the stringent quality requirements of each industry.

Cognex solutions help customers improve manufacturing quality and performance by eliminating defects, verifying assembly, and tracking information at every stage of the production process. Smarter automation using Cognex vision and barcode reading systems means fewer production errors, which equates to lower manufacturing costs and higher customer satisfaction. With the widest range of solutions and largest network of global vision experts, Cognex is the best choice to help you **Build Your Vision.™**

**\$1.04
BILLION**
2021 REVENUE

OVER 41
YEARS IN THE BUSINESS

500+
CHANNEL PARTNERS

GLOBAL OFFICES IN
20+ COUNTRIES

3,500,000+
SYSTEMS SHIPPED



DEEP LEARNING-BASED SOLUTIONS FOR THE PACKAGING INDUSTRY

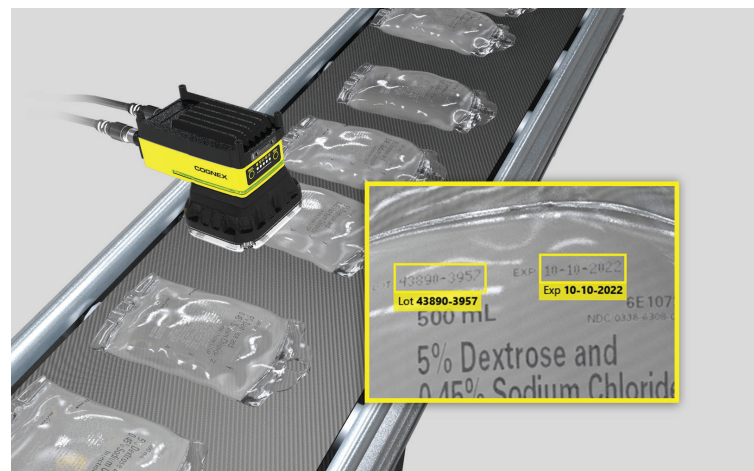
Automate complex applications – no machine vision or programming experience required

Packaging inspection applications in consumer packaged goods (CPG), food and beverage, pharmaceutical, and medical device industries are critical to ensuring product quality and safety. Faulty or damaged packaging can adversely affect how distributors and end users perceive product quality, safety, and value, or result in costly product recalls.

Cognex Deep Learning is an image-based analysis software designed to automate and scale a wide range of applications across the packaging industry. Combining human-like intelligence with the robustness of machine vision, Cognex Deep Learning performs judgment-based part location, inspection, classification, and character recognition tasks with high accuracy and repeatability.

Using an intuitive interface and common development platform, the software simplifies application development, allowing even non-vision experts to deploy reliable automation. Cognex Deep Learning can easily be adapted to meet changing needs, providing a future-proof solution that grows with your business.

- Digitalization**4
- Safeguard Packaging**5
 - Package Seal Inspection5
 - Contamination or Foreign Material Inspection.....6
 - Cosmetic Defect Inspection7
- Detect Wrong or Missing Items**8
 - Packaging Assembly and Kitting Inspections8
 - Missing Item Detection.....9
- Ensure Label and Code Quality**10
 - Label Print Quality Inspection10
 - Optical Character Recognition (OCR)11
 - Mislabeled Packaging Inspection12
 - Product Packaging Classification13
- Cognex Deep Learning Solutions**14
- Cognex Global Services**.....15



DIGITALIZATION & SELF-REGULATION

Industry 4.0 is driving change in the packaging industry as manufacturers seek to capitalize on emerging innovations in advanced automation. Machine vision, Big Data, cloud computing, and machine learning are revolutionizing manufacturing processes. Moving along the journey to Industry 4.0 presents an opportunity to digitalize processes that bolster productivity, reduce waste, improve product quality, enhance manufacturing flexibility, and decrease operating costs. Implementing a digitalization strategy also presents an opportunity to address ongoing labor shortage challenges.

As Industry 4.0 compatible edge systems and devices, Cognex machine vision and deep learning solutions create valuable digital data that serves two purposes. First, these systems capture real-time information such as inspection and measurement data that facilitates automatic in-line quality decisions. In addition, companies see great value in either feeding this data back into the process in real time or aggregating this data over time, performing off-line analytics, and using the resulting insights to drive process improvement and predictive maintenance. Cognex vision systems facilitate the digitalization of quality control processes through easy integration into industrial networks via standard communication and file transfer protocols such as TCP/IP, PROFINET, EtherNet/IP, SLMP, OPC/UA, and FTP.

Sample Use Case

The packaging industry is trending towards increased use of sustainable or recycled materials, which can be highly variable in their composition and appearance within a given production run. Given these variations, it is challenging to maintain consistent printing quality and contrast of valuable label information, such as regulatory codes and ingredients. To overcome this challenge, a machine vision or deep learning system can provide inspection data in a closed loop process with the marking system so it can automatically respond to the variations in contrast by adjusting the marking power in real time.



SAFEGUARD PACKAGING

Package Seal Inspection

Challenge

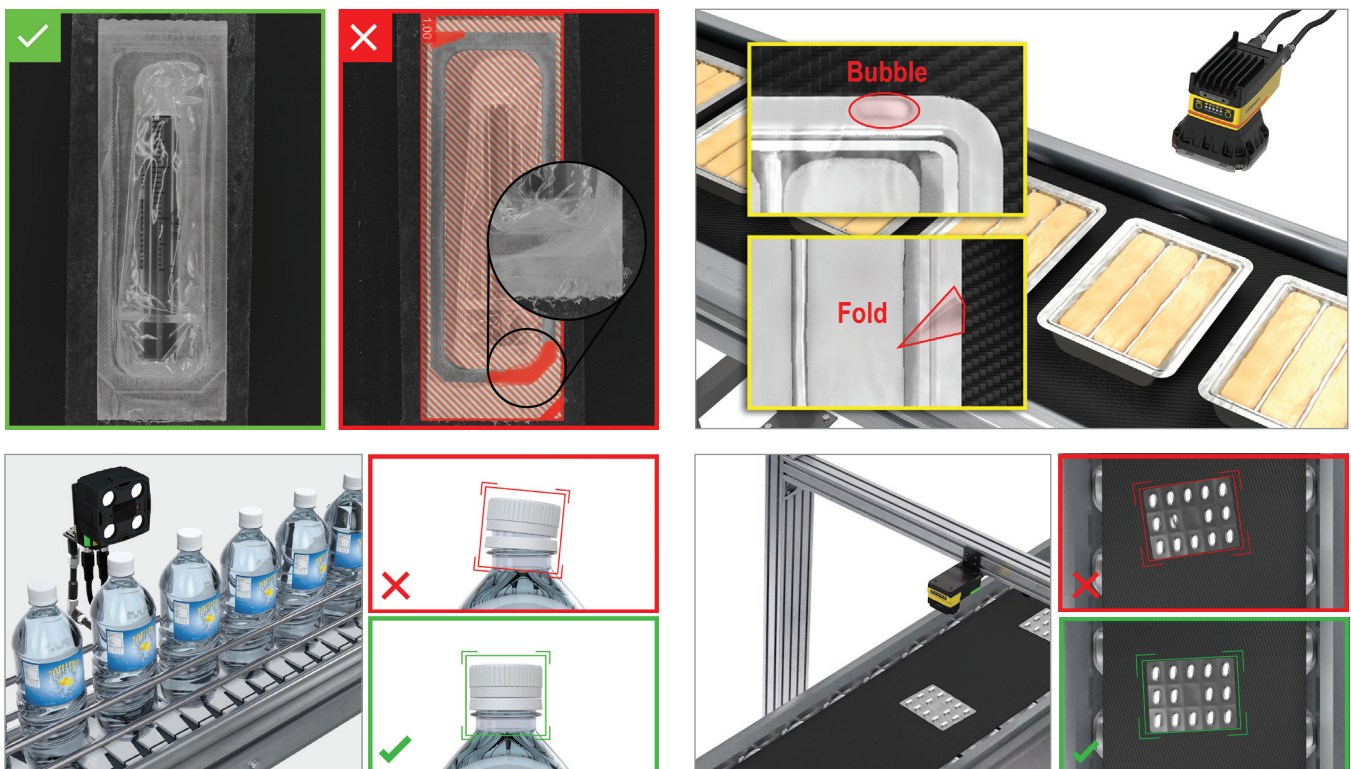
Seal integrity is critical to ensure packages are sterile and contaminant-free. The cost of product recalls or returns caused by contamination, spoilage, or foreign materials can be significant. Seal inspection is notoriously challenging using conventional vision systems due to changes in appearance of defects and the high amount of possible failure modes that can occur when sealing products. Shifts in particle size, contrast variations and random defects that differ in appearance, lead to high rejection of good product or potentially dangerous products being shipped to customers. Rule-based vision systems struggle to adjust to the changes and cannot classify or quantify the specific reasons the seal failed.

Solution

Cognex deep learning-based technology reliably identifies foreign matter, void seals, contamination, and a host of other issues that can impact a product seal. With 100% visual inspection, operator errors are eliminated and efficiency is optimized. Deep learning can take this a step further by highlighting the issues in real time, allowing operators or machines to clearly point out the issue and later categorize the problem.

Benefits:

- Ensure sterile and contaminant-free packages
- Avoid product recalls and returns
- Optimize efficiency with automated inspection
- Label, categorize, and understand failure modes



Contamination or Foreign Material Inspection

Challenge

Contamination and foreign material, such as air pockets, dust, particles, or hair, are still one of the major causes of product recalls in the medical device, pharmaceutical, and food and beverage industries. Ensuring consistent product quality with little operator intervention enhances and preserves brand reputation while maximizing productivity and investments.

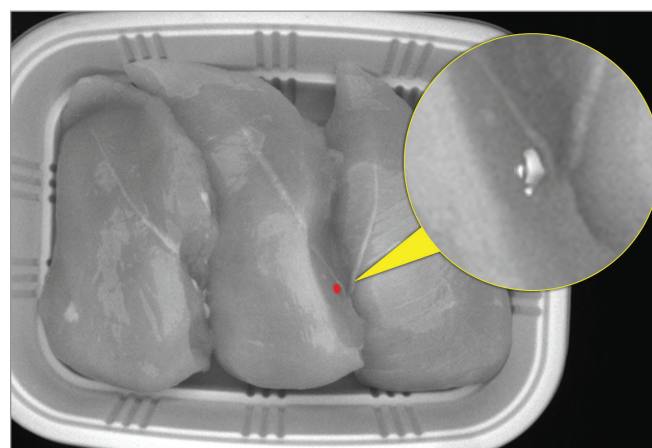
Relying on human quality inspection can be costly, particularly when looking for defects in high-speed production environments. Operators are required to perform mundane and repetitive tasks such as looking through microscopes on a work bench. Due to the variation in product and potential defects, traditional machine vision is time-consuming to develop and optimize for an operator dependent inspection.

Solution

Cognex deep learning-based solutions locate, analyze, and classify complex contamination issues in real time to stop contaminants from entering the supply chain—everything from pack confirmation to micro-contamination on high volume lines. Deep learning combines the human-like inspection capabilities with the automation, scale, and repeatability of a computerized system. This can be augmented by the use of robotics to ensure machine handling and vision tools work together to inspect the most complex anomalies sometimes missed by operators. The end result is less recall events, lower rework costs, and full product image capture and traceability.

Benefits:

- Defend against contaminants and foreign materials
- Limit the risk of product recalls
- Extract, capture, and categorize data
- Preserve brand reputation



Cosmetic Defect Inspection

Challenge

Before shipping a product or component, it is imperative to give it a final check to ensure product consistency and quality. This inspection is especially important in regulated industries where poor packaging quality can lead to recall events or customer complaints.

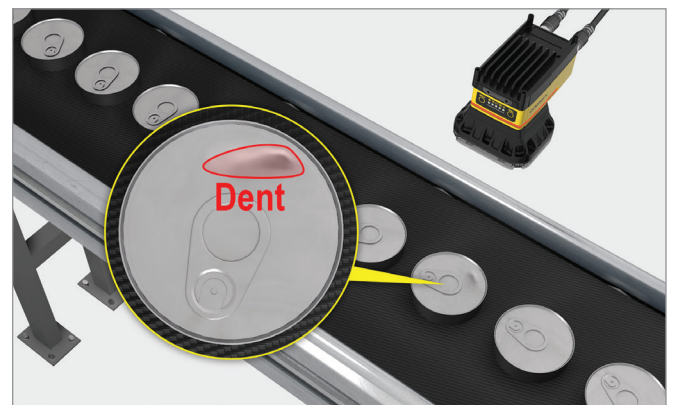
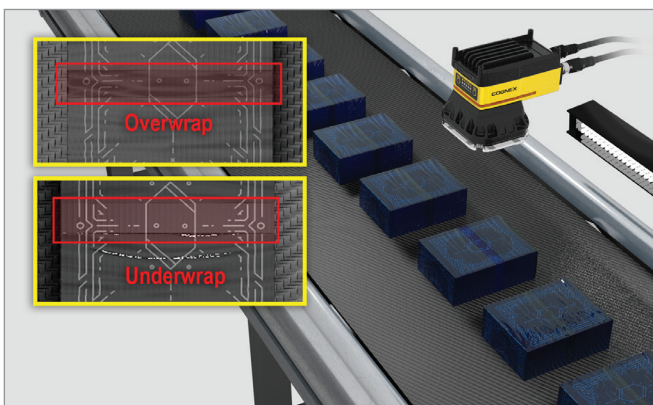
Conventional vision technology can often miss complex cosmetic packaging defects such as bubbles in labels, color degradation, scratches, cracks, overprint, and over-wrap or under-wrap issues. These types of unpredictable defects or variations are easy to discern by human inspectors, but very difficult to program with rule-based machine vision algorithms.

Solution

Cognex deep learning-based image analysis software detects defects on rough and textured metal surfaces as reliably as human inspectors, but with the speed of a computerized system. The defect detection tool catches defects on coarse material with standard illumination, even when image quality is poor, by forming a reliable model of the part's shape and texture based on training images. From here, it identifies deviations in the surface texture as anomalies and uses a classification tool to classify them as hits or scratches.

Benefits:

- Ensure high quality packaging standards are met
- Capture defects on challenging surfaces
- Guarantee customer satisfaction



DETECT WRONG OR MISSING ITEMS

Packaging Assembly and Kitting Inspections

Challenge

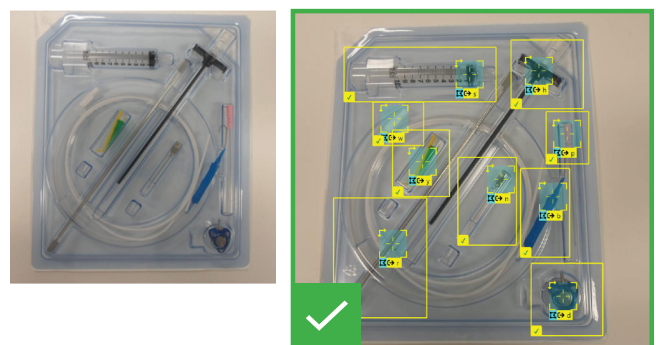
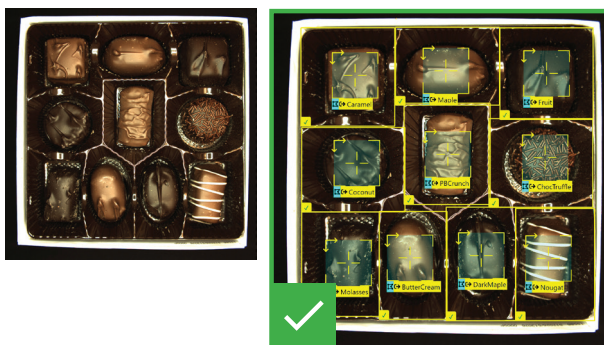
For certain packaging applications, manufacturers must rely upon visual inspection to ensure the quality of final assembly. Visual variations of products can cause complications for an automated inspection system. The inspection system must successfully verify that the correct product, device, or piece of food is in the correct location in the package. This is the case for many consumer packaged goods and medical device kitting applications, where the inspection system must be able to identify, count, and classify different items pre-assembly with varying package orientations, reflective surfaces, and complex geometries.

Benefits:

- Ensure proper items are in correct location
- Eliminate rework
- Preserve brand reputation

Solution

Cognex deep learning-based systems and software automate the tasks of locating, identifying, and classifying multiple features within a single image. It generalizes the distinguishing features of various items based on their size, shape, and surface features. A user can train the part location and assembly verification tool to locate each type of item that will need to be found. Once trained, the image can be split into different regions where the tool will check for the presence of an item as well as verify that it is of the correct type. Multiple configurations can also be created for situations where a single line may have variations in packaging. In this way, a user can automate the verification of packaging using just one tool.



Missing Item Inspection

Challenge

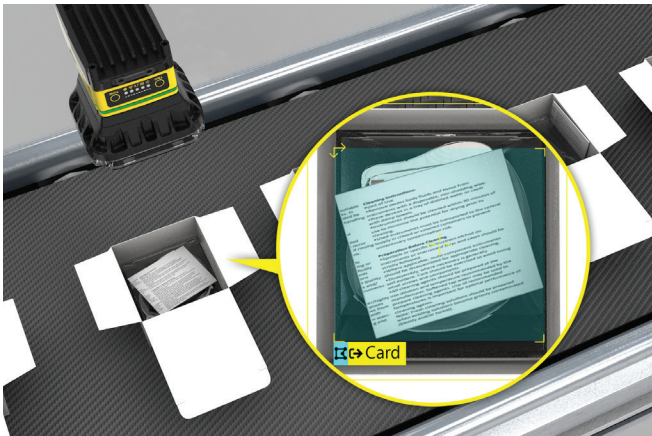
Manufacturers must detect missing items and verify the completeness of final packages before they are distributed in order to avoid costly chargebacks and returns as well as damage to their brand. During secondary packaging, items are wrapped and packaged in their final form. Quality inspections confirm the presence or absence of items inside the packaging before they leave the facility.

Solution

Cognex deep learning-based part location tool finds complex features and objects by learning from annotated images. Self-learning algorithms locate different types of vessels or vials on very noisy backgrounds or other complex objects in bulk. To train the tool, the user provides images where the targeted features are marked.

Benefits:

- Detect presence or absence of items
- Avoid costly returns
- Maintain customer satisfaction



ENSURE LABEL AND CODE QUALITY

Label Print Quality Inspection

Challenge

Labels contain product-specific data such as origin, date, expiry, amount, or class. In many factories, machine vision controls the alignment and placement of labels, as well as the inspection. Smudged ink and low-contrast printing commonly affect print and apply inkjet labels, jeopardizing readability.

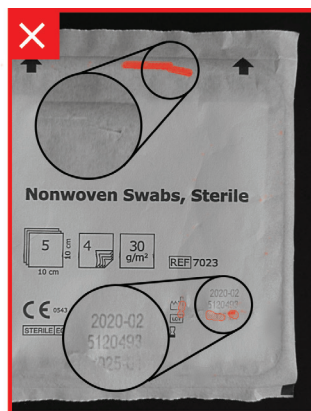
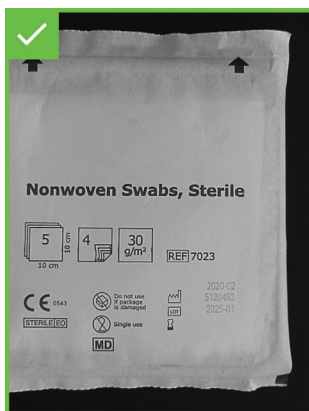
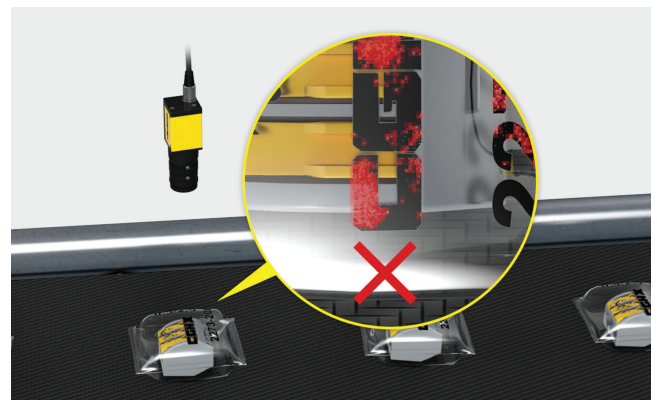
During the label application process, many defects are hard to detect due to the orientation on the belt and the curved surfaces of items. In the case of transparent packaging, even the human eye has trouble distinguishing the packaging print from the package contents. Printing errors and poor label quality require manual intervention, slowing down production and presenting challenges to vendors and partners.

Solution

Cognex deep learning-based technology quickly and easily identifies anomalies during packaging print inspection. It trains on a set of images of good package printing over a range of possible content backgrounds. The defect detection tool then instantly detects any printing errors, even against complex and changing package contents. If packaging design changes, the defect detection tool retrains on a set of images of the new packaging and can be deployed quickly without significant downtime.

Benefits:

- Detect label defects or errors
- Meet required quality standards
- Guarantee customer satisfaction



Optical Character Recognition (OCR) for Packaging

Challenge

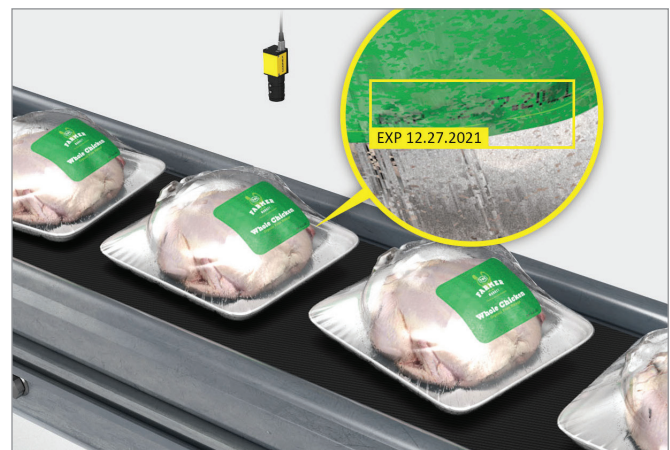
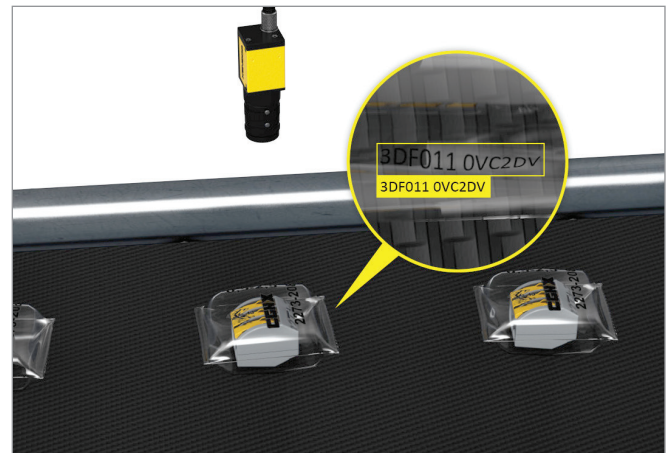
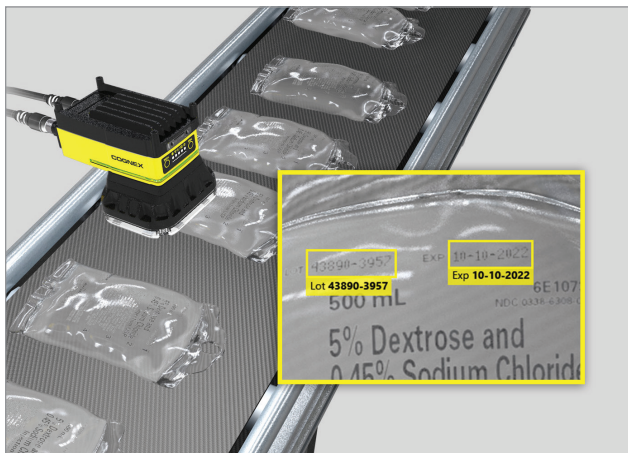
Date and lot codes, batch codes, and expiration dates are required on products across industries to identify when and where a product was made. Items are marked with these codes early in the production process for quality control and traceability. These codes often combine 1D symbologies and plain text to encode information about the batch and manufacturing date. Codes on medical device and pharmaceutical products might also have challenging surfaces that are curved, highly reflective, or transparent. OCR is used for reliable process control, helping manufacturers meet labeling requirements and ensure customer safety. Quality inspections must verify that the codes are present and printed correctly to ensure traceability and more easily manage recalls.

Solution

For challenging OCR including laser-engraved, dot peen, or chemically-etched DPM text, Cognex deep learning-based OCR solutions ensure codes are accurately read and verified. Deep learning deciphers deformed, skewed and poorly etched characters using OCR and optical character verification (OCV). The pretrained, omni-font library identifies most text without additional programming or font training.

Benefits:

- Detect presence or absence of codes
- Confirm accuracy of code data
- Ensure quality control and traceability



Mislabeled Packaging Inspection

Challenge

Manufacturers take great measures to avoid labeling mix-ups that, at best, damage brand reputation and at worst can lead to expensive recalls and liability. Many product manufacturers print and scan 1D and 2D barcodes or text on items to ensure they are labeled accurately and advertise the correct contents. These barcodes or alpha numeric values are used to verify that packages contain all of the correct components.

Solution

Cognex deep learning-based solutions can check that lids and containers match each other and accurately reflect the package contents, as well as confirm that labels comply with in-house procedures and standards imposed by regulatory bodies. Cognex technology ensures codes and text can be read and decoded at high speeds in the most challenging environments.

Benefits:

- Avoid product recalls due to mislabeling
- Ensure accurate labels and contents
- Meet regulatory label requirements
- Preserve brand trust



Categorize different part variations

Challenge

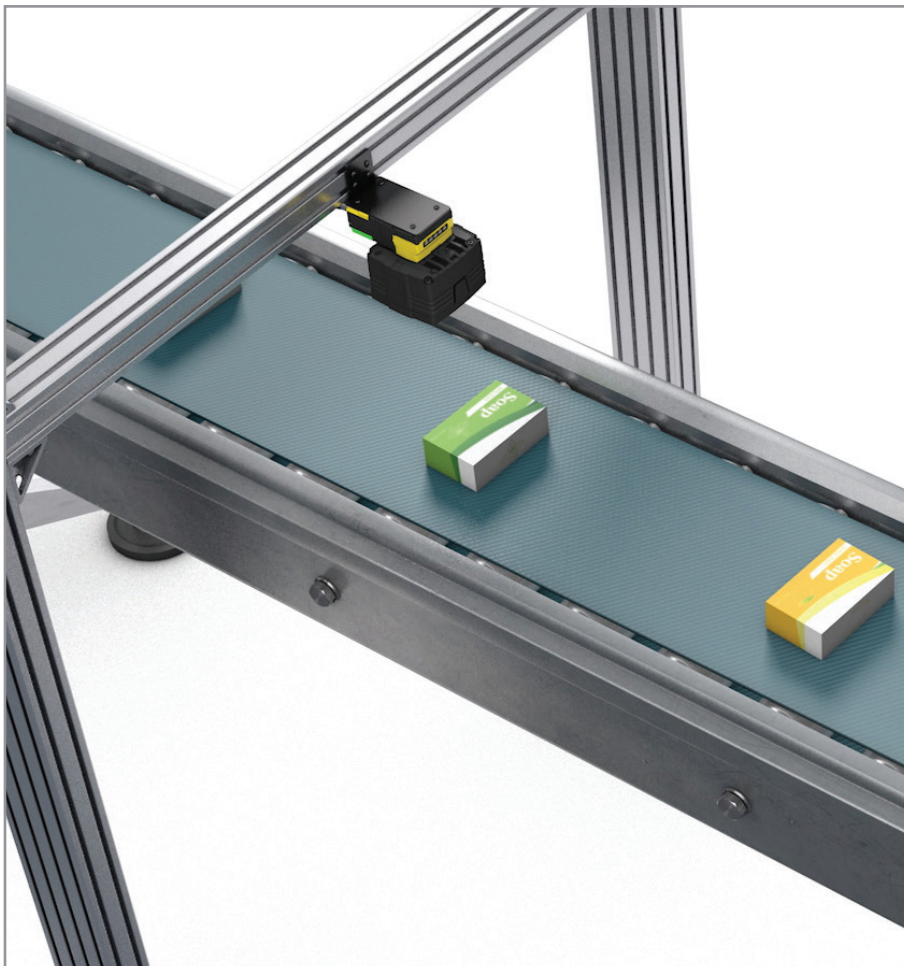
Manufacturing inspection systems often must identify products through packaging without the use of a barcode. In the case of food and beverage and consumer products, certain types of products may vary only by ingredients, flavor, color, or scent, yet their packaging may be almost identical. The inspection system needs to instantly recognize that the subtle differences in wrapping—which can be hard to detect under certain lights—result in different categories of packages. Training traditional machine vision systems to recognize these differences would be too time consuming and complex.

Solution

Cognex deep learning-based vision systems use a human-like approach to learn to distinguish between the multiple different categories of packages. By training the system with labeled images of the different packaging options, and using classifier tools, the system learns which packaging goes with which product and sorts them accordingly. Cognex technology ensures accurate product identification, even under challenging lighting conditions.

Benefits:

- Facilitate product sorting
- Distinguish true defects from normal deviations
- Reduce scrap rates
- Decrease costs



COGNEX DEEP LEARNING SOLUTIONS

Cognex Deep Learning optimizes productivity by leveraging state-of-the-art technology based on field-tested, industry-proven machine learning algorithms. Rather than following a rule-based approach to solving inspection challenges, like traditional machine vision, Cognex Deep Learning solutions learn to spot patterns and anomalies from reference images. Deep learning automates and scales complex inspection applications that, until now, still required human inspectors such as defect detection and final assembly verification.

In-Sight 2800 Series

The In-Sight 2800 vision system combines deep learning technology with traditional rule-based vision tools to solve a range of error-proofing tasks. From simple presence/absence detection to more advanced categorization and sorting applications, this fully integrated vision system offers an easy-to-use solution for automating inspections.



In-Sight D900 Series

The In-Sight D900 vision system leverages advanced deep learning tools to solve challenging OCR, assembly verification, and defect detection tasks. Processing takes place on-device, which eliminates the need for a PC, simplifying application deployment and bringing the power of deep learning to non-programmers.



VisionPro Deep Learning

VisionPro® Deep Learning is a deep learning vision software that automates highly variable applications by tolerating natural variation, while successfully differentiating between acceptable and unacceptable anomalies. Its graphical, point-and-click programming environment makes it easy to configure jobs and enables users to generate inspection results, fast.



COGNEX GLOBAL SERVICES

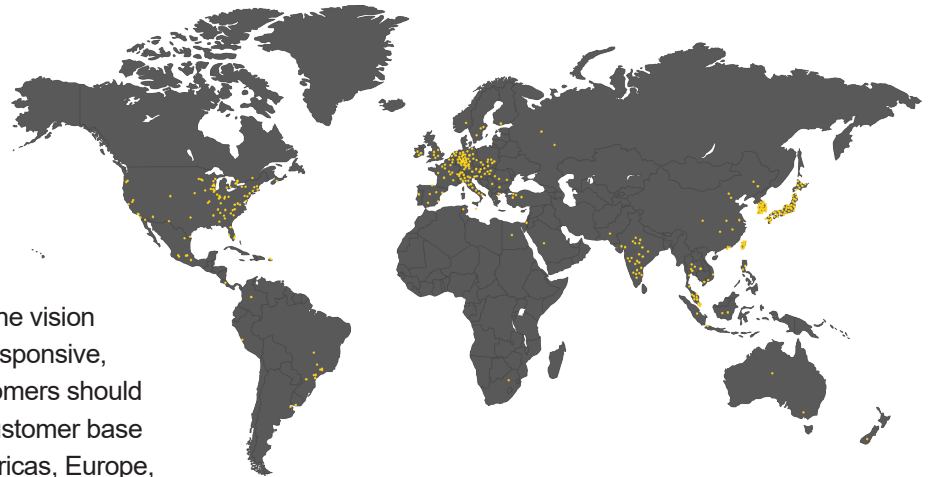
Customers get more than software when they purchase from Cognex. They get a company focused exclusively on machine vision, with the most comprehensive application experience. Add direct, high-quality worldwide service and support, and it's easy to see why Cognex is the machine vision company that industries rely on.

Technical Support
Product Training
Hardware Programs
Product Lifecycle

When it comes to protecting your machine vision investment, Cognex understands that responsive, expert service is an expectation all customers should have. Cognex serves an international customer base from offices located throughout the Americas, Europe, and Asia and through a global network of highly-trained partners, system integrators, and distributors.

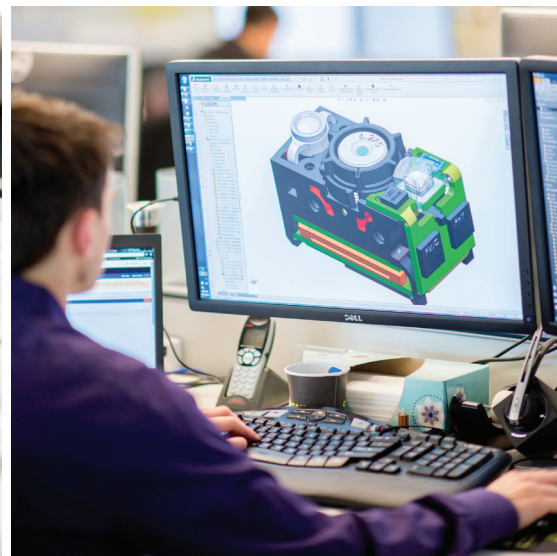
From development to deployment, Cognex is there to help you get your vision systems up and running as fast as possible. Whether you're considering machine vision for the first time or are already an expert user, Cognex global services provide the expertise to help your organization succeed.

cognex.com/support/cognex-services



Offices in **20+** countries

500+ Global Partners
in 30 Countries



BUILD YOUR VISION WITH CONFIDENCE

2D VISION SYSTEMS

Cognex machine vision systems are unmatched in their ability to inspect, identify and guide parts. They are easy to deploy and provide reliable, repeatable performance for the most challenging applications.

www.cognex.com/machine-vision



3D VISION SYSTEMS

Cognex laser profilers and area scan 3D vision systems provide ultimate ease of use, power and flexibility to achieve reliable and accurate measurement results for the most challenging 3D applications.

www.cognex.com/3D-vision-systems



VISION SOFTWARE

Cognex vision software provides industry leading vision technologies, from traditional machine vision to deep learning-based image analysis, to meet any development needs.

www.cognex.com/vision-software



BARCODE READERS

Cognex industrial barcode readers and mobile terminals with patented algorithms provide the highest read rates for 1D, 2D and DPM codes regardless of the barcode symbology, size, quality, printing method or surface.

www.cognex.com/barcodereaders



COGNEX

Companies around the world rely on Cognex vision and barcode reading solutions to optimize quality, drive down costs and control traceability.

Corporate Headquarters One Vision Drive Natick, MA 01760 USA

Regional Sales Offices

Americas

North America +1 844-999-2469
Brazil +55 11 4210 3919
Mexico +800 733 4116

Europe

Austria +49 721 958 8052
Belgium +32 289 370 75
France +33 1 7654 9318
Germany +49 721 958 8052

Hungary +36 800 80291
Ireland +44 121 29 65 163
Italy +39 02 3057 8196
Netherlands +31 207 941 398
Poland +48 717 121 086
Spain +34 93 299 28 14
Sweden +46 21 14 55 88
Switzerland +41 445 788 877
Turkey +90 216 900 1696
United Kingdom +44 121 29 65 163

Asia

China +86 21 6208 1133
India +9120 4014 7840
Japan +81 3 5977 5400
Korea +82 2 530 9047
Malaysia +6019 916 5532
Singapore +65 632 55 700
Taiwan +886 3 578 0060
Thailand +66 88 7978924
Vietnam +84 2444 583358

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Lit. No. DLPKGISG-06-2022

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