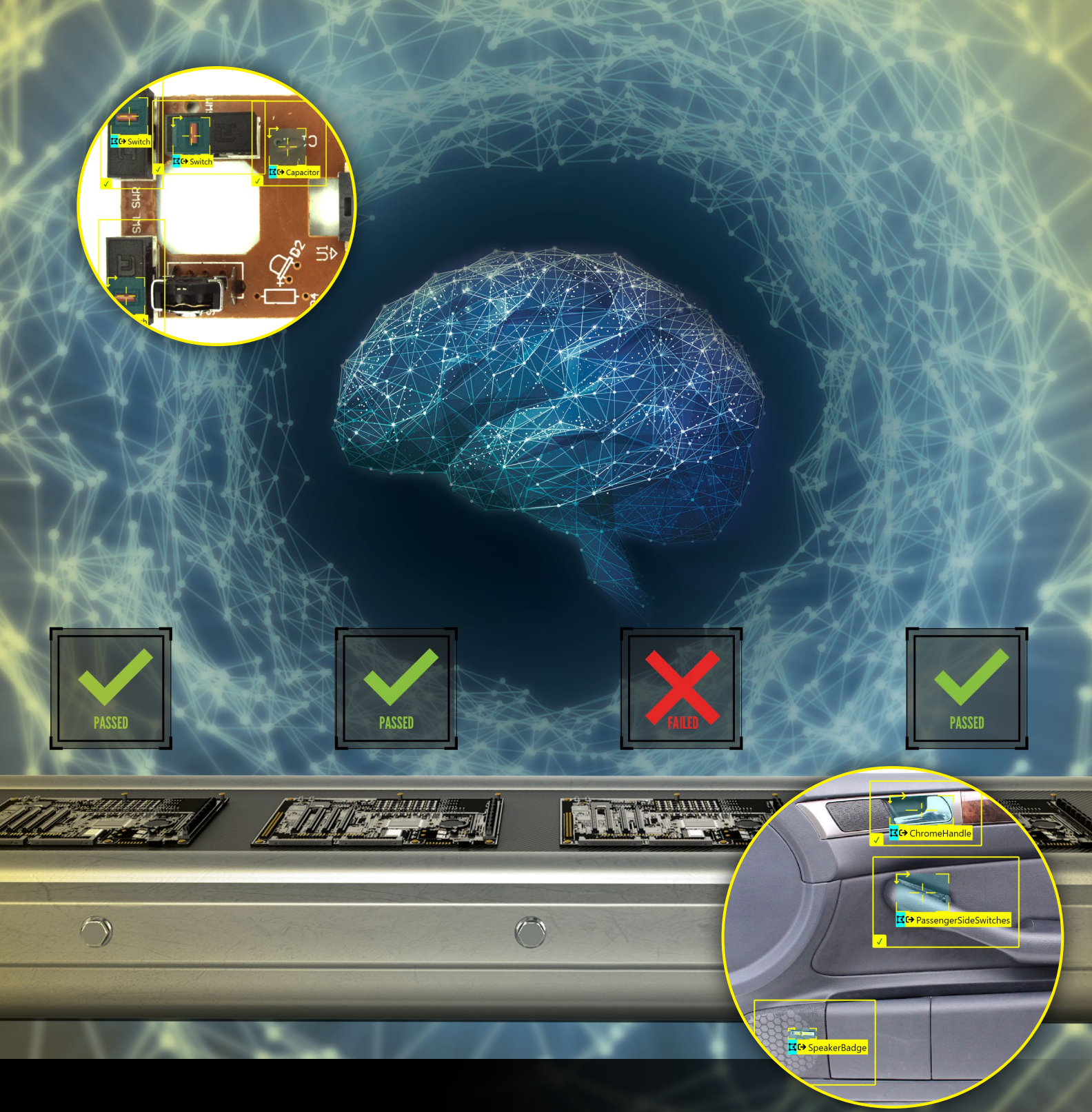



# COGNEX DEEP LEARNING SOLUTIONS

## Assembly Verification

COGNEX

# 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 million systems installed in facilities around the world and over forty 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.™**

**$811 MILLION**
2020 REVENUE

**OVER 40**
YEARS IN THE BUSINESS

**500+**
CHANNEL PARTNERS

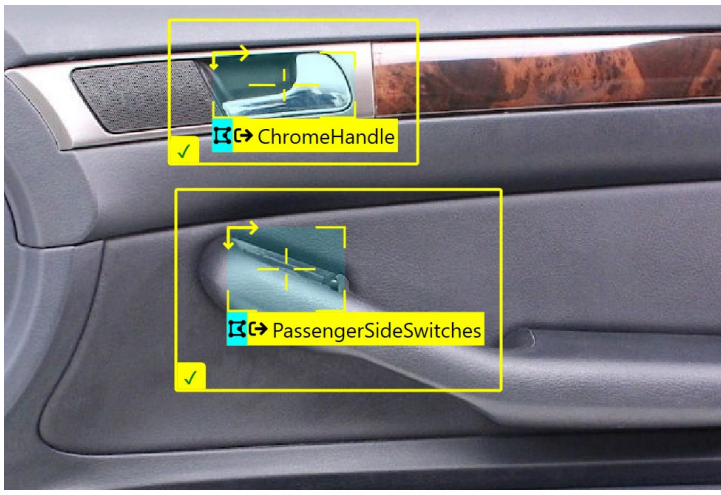
GLOBAL OFFICES IN
**20+ COUNTRIES**

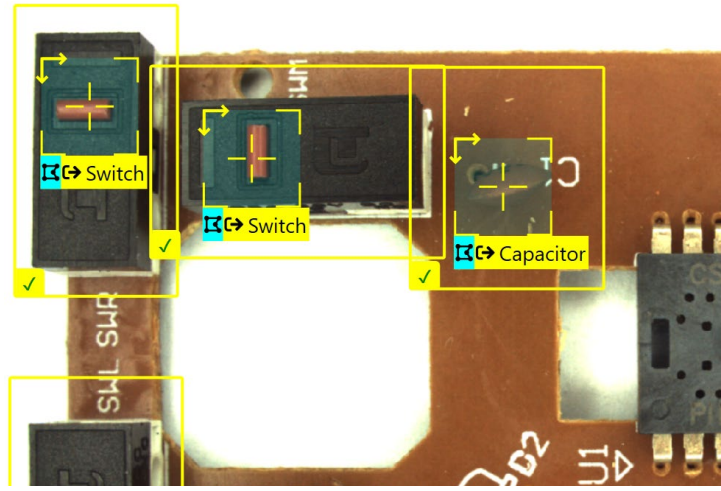
**3,000,000+**
SYSTEMS SHIPPED

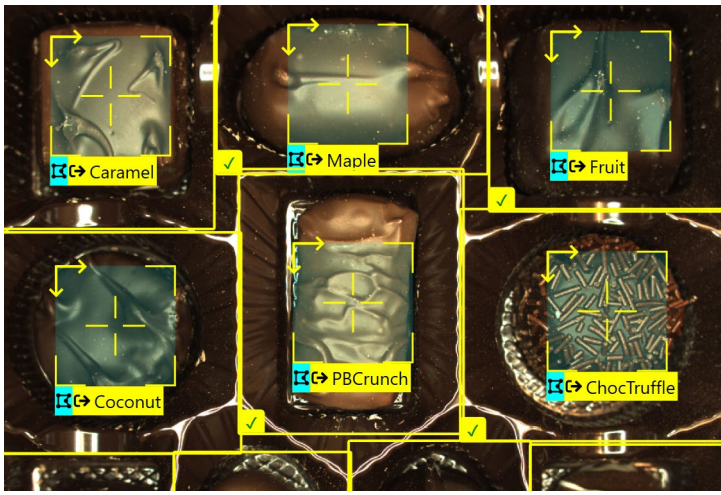
# COGNEX DEEP LEARNING SOLUTIONS FOR ASSEMBLY VERIFICATION

Today's machine vision algorithms can distinguish parts by even the subtlest of differences in markings or features. And yet, limitations exist. It is very programming-intensive to develop rules for the hundreds or even thousands of variations that a single part can present to a camera. Even with the best-written rules, the highly complex scenes involved in assembly verification applications can be too difficult to control. In particular, part-to-part variation, large numbers of components, and configuration changes are difficult and time-consuming to program using traditional machine vision. Deep learning vision software offers a breakthrough method to automate this class of inspection. Cognex Deep Learning Solutions can be trained to handle wide ranges of part-to-part variation in order to locate and confirm whether components are present and correct. It can also recognize multiple types of components within varying layouts and configurations—no additional logic-building required.





# AUTOMOTIVE
## FINAL ASSEMBLY VERIFICATION

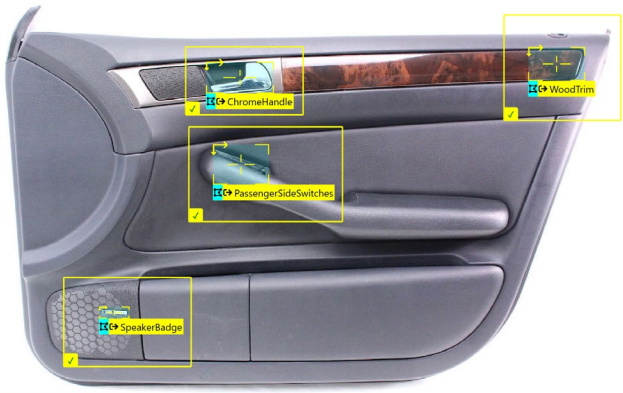
### Ensure all automotive components are present and correctly assembled using deep learning software

**Problem**

Machine vision is used throughout the automotive component manufacturing process to rigorously monitor and catch quality defects. Final assembly verification has traditionally been done with human operators, as the various pieces of trim involved in final assembly introduce a high degree of complexity that challenges traditional machine vision inspections. Human inspectors verify that all parts, such as interior pieces like door trim, window switches, and door handles, are present and correctly assembled. Exterior checks for color, badges, headlights, and other components are also done at the final stage of car assembly. Human inspectors, though skilled at identifying varying parts as different models move down the line under changing lighting conditions, can be slow and inconsistent.

**Solution**

Cognex Deep Learning learns the finished appearance of the many car components to identify improperly placed parts. It is able to do this as accurately as a human inspector, but with the speed and reliability of an automated system. Using the assembly verification and part location tool, a user can build up a component library of trained features. This library of components can contain a wide range of parts, from badges to door handles, for the tool to locate and identify within the image. By adding a verification step, the software can provide a pass or fail result based on all of the components that must be assembled. Using this approach, final assembly verification can now be automated.



# PRINTED CIRCUIT BOARD
## ASSEMBLY VERIFICATION

### Identify and count PCB components to ensure correct assembly using deep learning software

**Problem**

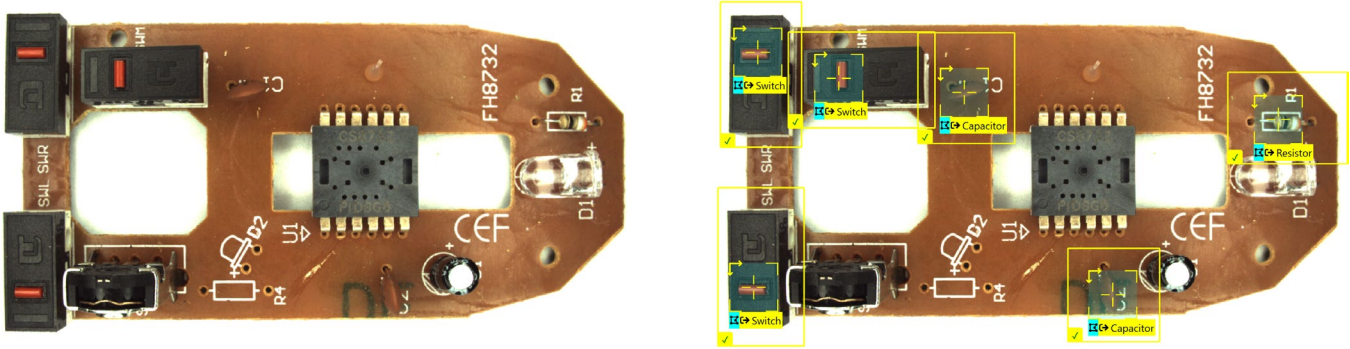
During final assembly verification, 2D and 3D machine vision systems traditionally inspect PCBs for the presence and correct placement of LEDs, microprocessors, and other surface mount devices. Wrongly positioned or missing components can impact a PCB's performance and lifespan. Manufacturers must be vigilant for scratched, twisted, bent, or missing pins. A chip has such low tolerances for error that any flaw, even the most superficial, is cause for rejection.

These errors must be caught before PCBs are assembled into devices or shipped to customers. Yet slight variations in appearance—whether due to subtle lighting contrasts, changes in perspective and orientation, or glare on metallic surfaces—can confuse an automated inspection system. Parts which are close together are difficult for a machine vision system to distinguish as independent components. Programming these inspections into a rule-based algorithm is time-consuming, prone to error, and challenging for a field engineer to maintain. Human inspectors, though capable of identifying these components, cannot meet the high-speed processing demands.

**Solution**

Cognex Deep Learning offers a field-maintainable solution for PCB assembly inspection. The assembly verification tool learns to identify the components from images labeled with locations of each part type, building a reference model of each component within a single tool. This tool generalizes the distinguishing features of the parts based on their size, shape, and surface features and learns their normal appearance, as well as their general location on the board. The system is also optimized to work with images that are low-contrast or are poorly captured.

In production, the tool analyzes all the relevant areas of the board to locate and identify each component, despite changes in appearance. This solution is able to determine whether the components are present or absent and verifies that the correct component is being used. In this way, the tool can provide a reliable solution to automate complex PCB assembly inspection.



# CHOCOLATE
# ASSEMBLY VERIFICATION

## Identify, count, and verify chocolates based on their appearance for packaging and assembly verification using deep learning software

### Problem

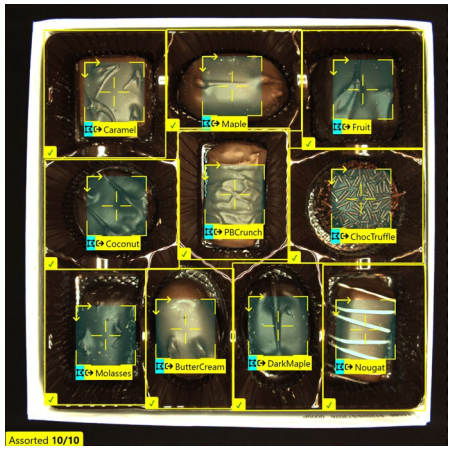
For certain food packaging applications, manufacturers must rely upon visual inspection to ensure the quality of the final assembly. Visual variations of food products can cause complications for an automated food and beverage inspection system. This is the case for chocolates, which arrive for packaging in differently configured boxes. The inspection system must successfully verify that each spot contains a piece of chocolate and that it is of the correct type.

Holiday-themed (i.e. Christmas or Valentine's Day) chocolate boxes present a particular challenge. The same chocolates may be present in the boxes, but their position may change based on the box's theme. The manufacturer must locate each chocolate and verify the correct type is in the correct position. Similarly, two chocolate boxes might use the same packaging (i.e. box of 6 chocolates) but be filled with different flavors (i.e. milk vs. dark chocolate selections). In this case, the manufacturer needs to count the chocolates and verify the correct chocolate selection is present.

### Solution

Cognex Deep Learning automates the task of locating and identifying multiple features within a single image. Deep learning technology can generalize the distinguishing features of various types of chocolate based on their size, shape, and surface features. With the assembly verification tool, a user can train the tool to locate each type of chocolate that will need to be found. Users can build a database of various types of chocolates for the tool to find, which can then be used for packaging verification.

Once trained, the image can be split into different regions where the tool will check for the presence of a chocolate 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 chocolate packaging using just one tool.



# TRIM
## FINAL ASSEMBLY INSPECTION

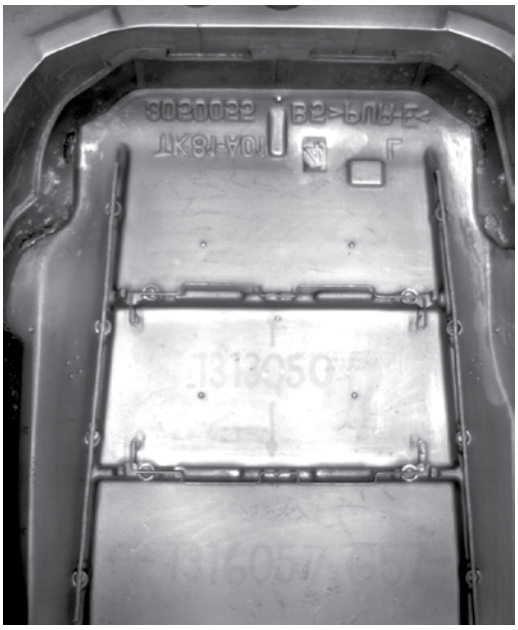
### The defect detection tool confirms the presence and placement of components on a confusing background

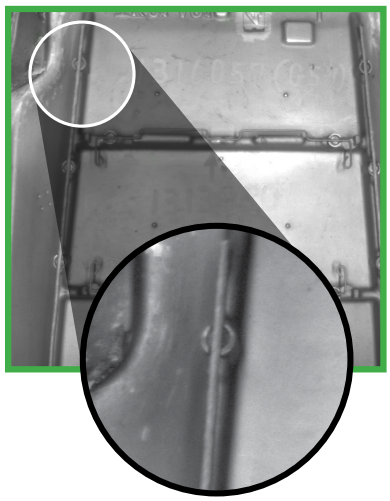
**Problem**

The various pieces of trim involved in final assembly verification introduce a high degree of complexity that challenges traditional machine vision inspections. Human inspectors verify that all parts, such as wire bands and metal housings, are present and correctly assembled. Subtle lighting variations make it difficult to tell whether the bands are in their correct housing. Human inspectors, though skilled at identifying wire bands, can be slow and inconsistent. Cognex Deep Learning analyzes the finished appearance of a piece of trim and identifies missing bands as accurately as a human inspector, but with the speed and reliability of an automated system.

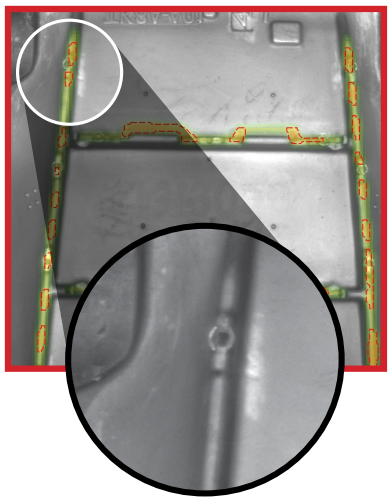
**Solution**

Using the defect detection, a technician trains the system on “bad” images of trim where the wire is absent, as well as known “good” images where the wire is present, to create a reference model for a complete piece of trim. Using this model, deep learning identifies trim pieces with missing wire bands as anomalous and defective, failing them during final inspection.





Wire present



No wire

# COGNEX DEEP LEARNING SOLUTIONS

Cognex Deep Learning is the first set of deep learning-based vision solutions designed specifically for factory automation. The field-tested, optimized and proven technology is based on state-of-the-art machine learning algorithms.

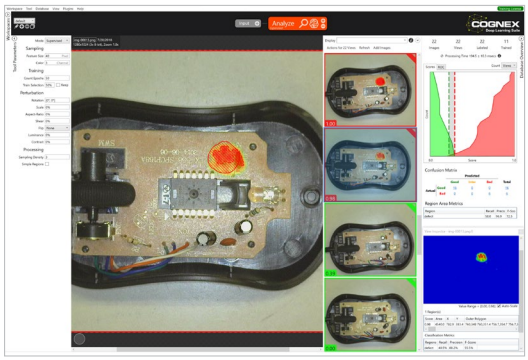
Rather than following a rule-based approach to solving inspection challenges, like traditional machine vision applications, Cognex's deep learning solutions learn to spot patterns and anomalies from reference image examples. Deep learning automates and scales complex inspection applications that until now still required human inspectors such as defect detection and final assembly verification.

## In-Sight ViDi

In-Sight® ViDi deep learning applications are deployed on the In-Sight D900 smart camera without the need for a PC, making deep learning technology accessible to non-programmers. It uses the familiar and easy-to-use In-Sight software platform which simplifies application development and factory integration.

## VisionPro Deep Learning

VisionPro Deep Learning software combines a comprehensive machine vision tool library with advanced deep learning tools inside a common development and deployment framework. It simplifies the development of highly variable vision applications and allows engineers to build flexible, highly customized deep learning solutions tailored to their specific needs.



COGNEX

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